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PULP&PAPER

1990 NORTH AMERICAN FACT BOOK

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PULP & PAPER
A monthly magazine edited for the pulp, paper, and paperboard manufacturing industry and directed specifically toward management, supervisory, production, and technical personnel. Sent without charge, upon written request, to qualified individuals in the industry in the U.S. and Canada. (A thirteenth issue, a Buyers' Guide, is published in November.)

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Information in this volume is designed to present a
comprehensive review of the structure and status
of the pulp and paper/board industry of
the United States and Canada. Every effort
has been made to provide accurate data.
To the best of the editors' knowledge,
data are reliable and complete,
but no warranty for this is made.

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NORTH AMERICAN OVERVIEW

North America is the world's most important pulp- and paper-producing region, accounting for about 50% of worldwide pulpmaking capacity and 40% of paper and paperboard capacity.

Paper and paperboard production has just about matched general economic activity during the 1980s. Printing/writing grades have shown strong growth because of the spread of smaller computers and the demand for higher-quality paper in advertising. Packaging grades have shown somewhat slower growth due to inroads by plastics in some market segments. Industry profitability improved strongly during the latter part of the decade, helped by favorable market conditions and the decline of the dollar.

The North American Overview is divided into two sections: United States and Canada. For each country, there is a chapter that examines trends in industry structure, production, exports/imports, prices, profitability, capital spending, capacity expansion, mergers and acquisitions, labor, timber resources, energy use, transportation, and environmental spending and regulations.

Financial data:	All sales and earnings figures are shown in U.S. dollars, unless indicated "C$" for Canadian dollars.
Production data:	All capacity production data are set in short tons of 2,000 lb, unless specifically indicated as metric. To convert to metric tons—multiply by 0.90718. To convert to short tons—multiply by 1.1023.

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INDUSTRY STRUCTURE

The U.S. pulp and paper industry battened down its hatches to ride out a storm of plunging prices, softening markets, restrictions on logging, and large environmental expenses. Earnings leveled out in mid-1989 and tumbled in the fourth quarter. Many in the business look for relief in the next year or two as capacity increases are absorbed and prices firm. And Prudential-Bache Securities noted that cyclical earnings declines in the paper industry during the last 30 years have lasted no more than 21 months from peak to trough.

Based on value of shipments, paper and allied products ranks eleventh among U.S. manufacturing industries, according to revised preliminary figures from the 1987 Census of Manufactures, the latest data available. Shipments of paper and allied products in 1987 totaled $108.3 billion, an increase of 10.6% over the previous year. The sector follows transportation equipment, food, chemicals, machinery, fabricated metal products, printing and publishing, petroleum and coal products, electrical machinery, primary metals, and instruments.

PAPER MACHINES IN OPERATION

	Number of machines			Machine capacity*
	1987	1980	1975	1987
Newsprint	41	43	38	6,006
Printing/writing	421	452	475	22,077
Packaging	183	205	228	5,492
Tissue	209	236	240	5,505
Total paper	854	919	981	39,080
Unbleached kraft	66	74	69	19,421
Solid bleached	27	30	31	4,735
Semichemical	38	47	51	5,682
Recycled	187	209	244	9,267
Total paperboard	318	360	395	39,105
Total paper and board	1,172	1,279	1,376	78,185

*000 short tons.
Source: American Paper Institute.

Paper and allied products shipments accounted for 4.4% of total U.S. manufactures in 1987. And the sector employed 611,000 workers, representing 3.5% of the U.S. manufacturing payroll, according to the census.

Ranked by sales of pulp, paper, and converted products, the largest company in the U.S. paper industry was International Paper Co., with revenues of $9.22 billion in 1989. IP burst to the head of the pack in 1986 as a result of its purchase of Hammermill Paper Co. James River Corp. persisted in second place, with revenues of $5.95 billion, and Kimberly-Clark Corp. held on to its third-place position by pulling in revenues of $5.58 billion. Stone Container Corp. moved up two notches from last year's ranking to fourth place with sales of $5.17 billion, followed by Scott Paper Co. with sales of $5.07 billion.

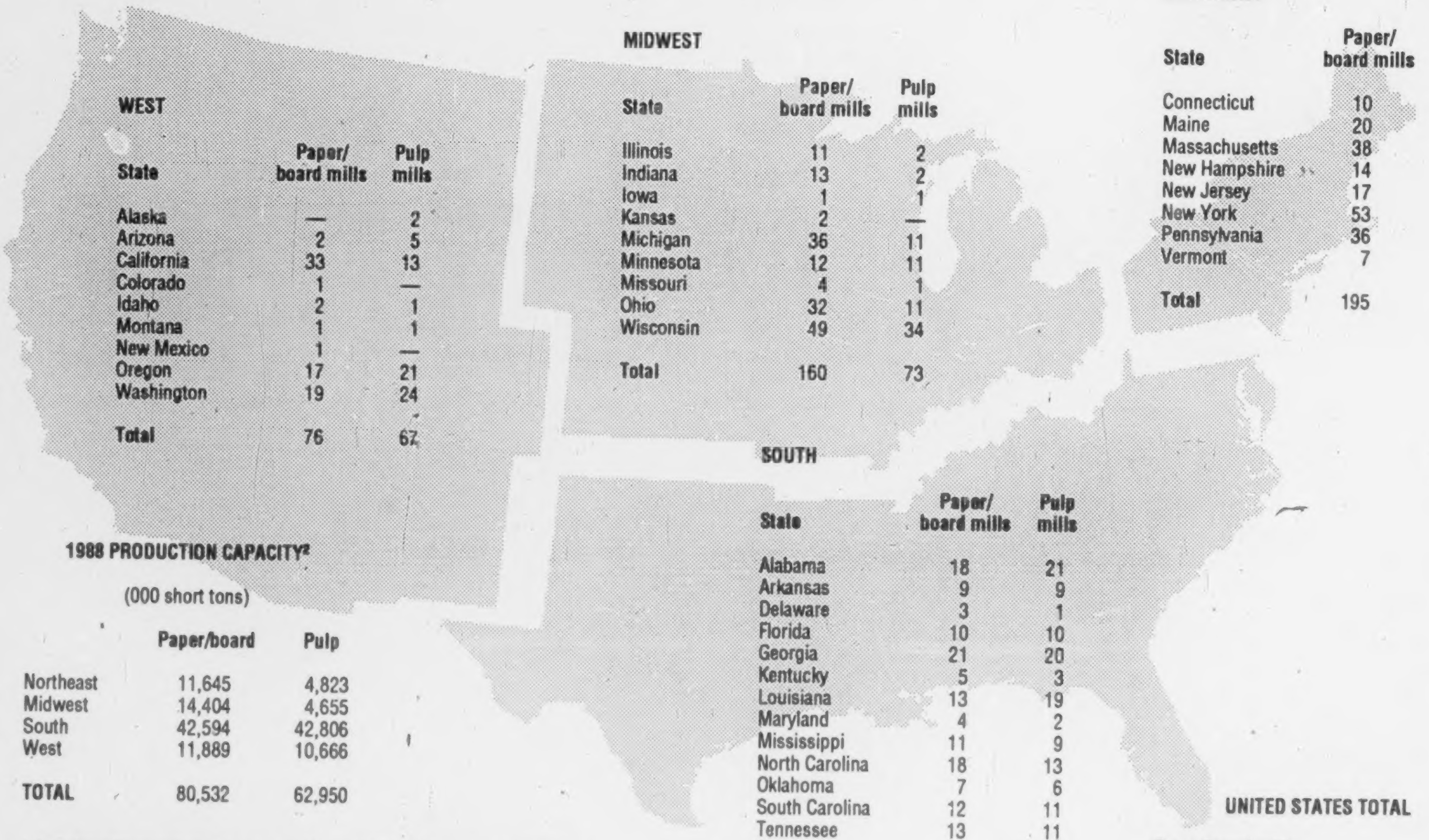
The latest Fortune 500 listing of the largest U.S. industrial companies, put together by *Fortune* magazine, contained 37 forest products firms—four more than last year. International Paper was first in the sector and captured thirty-fifth place among the 500, with total 1989 sales of $11.378 billion.

Following IP on the Fortune 500 were Georgia-Pacific Corp. in forty-first place, Weyerhaeuser Co. (last year's sector winner) in forty-second place, and James River at eighty-first. The last forest products company on the list was Tambrands, at No. 476, with sales of $583 million. The four newcomers to the list were First Brands, Pentair Inc., ITT Rayonier Inc., and St. Joe Paper Co.

The forest products sector slipped a bit from last year's stellar performance, even compared with other sectors. Median sales, which had jumped 13.8% in 1988, were up just 7.2% to $1.656 billion in 1989 for the 37 forest products

NUMBER OF PULP, PAPER, AND BOARD MILLS IN U.S., BY REGION

(Number of mill sites)[1]



WEST

State	Paper/ board mills	Pulp mills
Alaska	—	2
Arizona	2	5
California	33	13
Colorado	1	—
Idaho	2	1
Montana	1	1
New Mexico	1	—
Oregon	17	21
Washington	19	24
Total	76	67

MIDWEST

State	Paper/ board mills	Pulp mills
Illinois	11	2
Indiana	13	2
Iowa	1	1
Kansas	2	—
Michigan	36	11
Minnesota	12	11
Missouri	4	1
Ohio	32	11
Wisconsin	49	34
Total	160	73

NORTHEAST

State	Paper/ board mills	Pulp mills
Connecticut	10	1
Maine	20	21
Massachusetts	38	5
New Hampshire	14	2
New Jersey	17	3
New York	53	14
Pennsylvania	36	8
Vermont	7	2
Total	195	56

SOUTH

State	Paper/ board mills	Pulp mills
Alabama	18	21
Arkansas	9	9
Delaware	3	1
Florida	10	10
Georgia	21	20
Kentucky	5	3
Louisiana	13	19
Maryland	4	2
Mississippi	11	9
North Carolina	18	13
Oklahoma	7	6
South Carolina	12	11
Tennessee	13	11
Texas	12	10
Virginia	14	10
West Virginia	2	—
Total	172	155

UNITED STATES TOTAL

Paper/board mills	**603**
Pulp mills	**351**

1988 PRODUCTION CAPACITY[2]

(000 short tons)

	Paper/board	Pulp
Northeast	11,645	4,823
Midwest	14,404	4,655
South	42,594	42,806
West	11,889	10,666
TOTAL	80,532	62,950

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1. Includes mills manufacturing paper and/or paperboard, regardless of the number of paper machines and regardless of whether or not one or more pulp mills are located at the site.

2. Source: American Paper Institute. Excludes construction paper and board and woodpulp for this grade.

Source: *1990 Lockwood-Post's Directory.*

firms, putting the sector in fourth place among all industries. And median profits, which skyrocketed 45.0% in 1988—gaining the sector third place—slumped -5.3% the following year to $145 million, for an eighteenth-place finish. Return on sales for the forest products group were 7.1%, putting the sector in fourth place.

International Paper again was dominant as far as North American capacity is concerned. The firm laid claim to nearly 7 million tpy of capacity for both pulp and paper/board in 1989. IP was tops in pulp capacity, but Champion International Corp. came out ahead in paper/board alone, with more than 7 million tpy of capacity. Georgia-Pacific also was right up there, with pulp capacity topping 5 million tpy and paper/board capacity just over 4 million tpy.

The value of paper and allied products industry shipments—which had been increasing since 1985—appeared to be slumping slightly for 1990, according to Commerce Dept. figures available by mid-year. Shipments in 1985 had dropped 1.5% from the previous year to $93.41 billion. But the industry took off the following year, with shipments growing 11.2% to $103.83 billion. And 1987 was even better, resulting in a 14.5% spurt to $118.86 billion. The punch went out of the cycle the next year as shipments grew 7.5% to $127.72 billion and just 2.2% in 1989 to $130.50 billion. And the Commerce Dept. indicated that shipments would drop 0.2% to $130.23 billion for the year if they continued at the same rate as in the first half.

While primary production of pulp, paper, and paperboard represented 42% to 43% of the value of industry shipments for much of the decade, rising prices brought that share up to 45% in 1988 and 44% the following year. For 1990, these sectors were expected to account for 43% of shipments. The remainder is converted paper products and paperboard boxes and containers.

U.S. PAPER INDUSTRY VALUE OF SHIPMENTS RANKED WITH OTHER INDUSTRIES

(billion $)

	1987	1986	Change (%)
Nondurable goods industries [1]	1,199.7	1,078.3	11.3
Food, kindred products	330.1	308.5	7.0
Tobacco products	20.8	19.1	8.9
Textile mill products	63.5	55.3	14.8
Paper and allied products	108.3	97.9	10.6
Chemicals and allied products	230.1	197.1	16.7
Petroleum and coal products	130.7	124.9	4.6
Rubber and plastics products	86.3	73.4	17.6
Durable goods industries[1]	1,280.5	1,182.0	8.3
Stone, clay, and glass products	60.9	57.3	6.3
Primary metals	120.2	105.6	13.8
Fabricated metal products	148.3	138.0	7.5
Machinery, excluding electrical	220.1	208.5	5.6
Electrical machinery	172.1	196.2	-12.3
Transportation equipment	332.5	313.8	6.0
Instruments and related products	108.3	61.9	75.0
Total manufactured goods	2,480.2	2,260.3	9.7

1. Includes industries not shown.
Source: U.S. Dept. of Commerce.

Pulp, paper, and paperboard shipments apparently will shrink in 1990, after expanding since 1986. That year showed a burst of growth—up 20.0% to $46.99 billion. Over the next two years, primary products shipments rose 9.6% to $51.52 billion and 11.0% to $57.18 billion, respectively. But in 1989 that cut far back to 0.1% growth, and in 1990, shipments could shrink 3.6%.

In 1987, the latest year for which breakdowns are available, the value added by manufacturers of pulp, paper, and paperboard contributed 49% to the value of shipments vs 51% for the cost of materials, according to revised census figures. Within the sector, value added by manufacturers ranged from 49% for paper, to 50% for paperboard and 53% for pulp.

The North American paper industry continues to consolidate. The top ten paper-grade chemical market pulp producers held sway over 52% of capacity in 1989. And the top ten paper and paperboard manufacturers dominated 37%.

One of the most concentrated sectors is kraft paper, with 71% of total U.S. capacity in the hands of the top five producers in 1989 and 97% of capacity held by the top ten companies. The top five coated free-sheet manufacturers accounted for 62% of North American capacity in 1990, and the top ten were responsible for 89.7%. In the tissue sector, 74% of U.S. capacity is allocated to the top five producers in 1990 compared with 90% for the top ten.

The commodity grades are better distributed. The top five kraft linerboard companies hold 47% of U.S. capacity, and the top ten account for only 75%. In the uncoated free-sheet sector, five companies represent 49% of capacity, and the leading ten hold 73%.

Major mergers and acquisitions continue but at a slower pace than in the past four or five years. Morgan Stanley lists nine big paper deals in 1986, five in both 1987 and 1988, and just two in 1989.

The showiest attack on the acquisition front had to be Georgia-Pacific's feisty takeover of Great Northern Nekoosa Corp.—completed in early 1990—spawning the world's largest paper company, with combined 1989 sales of $14 billion. Analysts generally applauded the $3.7 billion purchase, noting that although short-term performance would be rough, the long term looked good. Prudential-Bache Securities said the acquisition "will enable the company to enjoy one of the fastest earnings growth rates in the industry through the mid-1990s as its balance sheet regains its previous strength."

Other recent merger and acquisition activity includes the merger of the U.S. operations of Jefferson Smurfit and Container Corp. of America, completed in December 1989. And the other major deal in 1989 was Stone Container Corp.'s $2.2-billion purchase of Consolidated-Bathurst Inc., Canada's fifth-largest pulp and paper company.

Just as companies are growing, so are the mills. Although the number of paper and paperboard mills operating in 1987 was approximately the same as the 544 listed for 1988, only 35 had a capacity over 500,000 tpy, compared with 40 in 1988. And while 137 of the mills produced less than 25,000 tpy in 1987, a year later only 130 mills manufactured that little.

TOP 25 NORTH AMERICAN PAPER/PRODUCTS COMPANIES 1989[1]

World ranking	Company	1989 sales[2] (000 US$)	% change 1989/88	Net profit[3] (000 US$)	% change 1989/88	1989 capacity (short tons/day)	
						pulp	paper/board
1.	International Paper	9,224,000	12.5%	864,000	14.6%	18,885	18,980
2.	James River	5,950,000	1.3	221,564	-14.8	7,145	8,907
3.	Kimberly-Clark	5,577,100	5.5	423,800	11.9	4,013	3,584
4.	Stone Container	5,165,300	41.3	285,800	-16.4	10,810	12,003
5.	Scott Paper	5,065,600	7.2	375,500	-6.3	4,833	7,088
6.	Georgia-Pacific	4,042,000	17.6	661,000	41.5	14,412	11,583
7.	Champion International	4,037,000	1.3	432,421	-5.3	10,604	19,793
9.	Weyerhaeuser	3,723,400	8.6	376,838	-26.9	11,750	10,525
19.	Noranda Forest*	2,434,100	-1.0	159,600	-28.1	3,584	2,519
20.	Boise Cascade	2,380,400	-1.1	267,580	-7.5	8,750	8,725
23.	Union Camp	2,147,900	4.7	299,400	1.4	8,000	7,900
24.	Westvaco	2,077,800	6.9	223,090	11.3	6,207	6,570
25.	Mead*	2,048,500	-2.0	215,800	-38.8	6,240	6,074
27.	Canadian Pacific Forest Products	1,996,600	-4.8	186,525	31.9	10,042	8,835
35.	MacMillan Bloedel	1,532,000	0.1	209,067	-25.2	6,548	5,400
36.	Domtar*	1,515,200	4.9	27,966	-70.3	3,809	4,729
37.	Temple-Inland	1,506,700	5.4	207,400	4.1	5,425	7,050
40.	Bowater	1,450,000	2.8	144,569	-12.0	5,825	4,455
43.	Abitibi-Price*	1,323,000	-10.6	45,932	-71.6	9,028	7,750
44.	Sonoco Products	1,292,500	-2.5	103,561	7.6	250	2,734
45.	Federal Paperboard	1,286,700	20.1	205,480	43.4	2,204	2,880
52.	Repap Enterprises	1,031,900	18.8	93,100	0.3	2448	2452
55.	Potlatch	968,000	13.6	136,715	21.7	2438	2687
56.	Consolidated Papers	948,000	6.3	167,919	12.0	1769	2690
62.	Gaylord Container	746,000	11.1	39,400	-6.0	—	3406

1. Canadian results have been converted to U.S. dollars and short tons.
2. Based on results from paper, pulp, and converting operations only.
3. Income from consolidated results, after taxes.

*Noranda Forest Inc. Includes 50% ownership of MacMillan Bloedel Ltd. 1989 financial results include Normick Perron.
Mead Corp. 1988 income includes $11.2-million gain in sale of business.
Abitibi-Price Inc. 1989 income includes C$31.2 million pretax charge for restructuring.
Domtar Inc. 1990 income reflects discontinued operations and a C$35-million pretax charge for restructuring.
Sources: *Pulp & Paper International*, *Pulp & Paper Week*.

U.S. CAPACITY INTEGRATED TO WOODPULP

(000 short tons)

	1988		1982		1976	
	Tons	%	Tons	%	Tons	%
Paper						
Newsprint	5,584	91.3%	5,212	92.2%	3,589	89.4%
Uncoated groundwood	1,382	79.7	1,515	91.5	1,093	83.5
Coated groundwood	4,209	96.8	3,093	95.4	2,218	96.5
Coated free-sheet	2,609	75.9	1,776	78.1	1,359	71.4
Uncoated free-sheet/ cotton fiber	9,397	77.9	7,384	80.3	4,837	64.8
Thin	81	28.7	106	28.7	57	15.9
Bristols	1,076	91.9	946	88.5	1,092	93.7
Packaging/industrial converting	3,945	73.0	4,887	80.4	5,071	81.8
Tissue	2,312	40.8	2,606	50.8	2,043	45.4
Total	30,596	76.1	27,525	79.4	21,359	73.1
Paperboard						
Unbleached kraft	20,269	100.0	17,402	100.0	14,568	100.0
Solid bleached	4,732	100.0	4,121	100.0	3,998	100.0
Semichemical	5,679	98.1	5,207	100.0	4,758	100.0
Recycled	774	8.1	346	4.0	513	5.8
Total	31,454	78.0	27,076	76.4	23,837	74.3
Total paper and board	62,050	77.0	54,601	77.9	45,196	73.7

Source: American Paper Institute.

U.S. MILL SIZE DISTRIBUTION FOR PAPER/BOARD AND WOODPULP

Mill capacity range (000 tpy)	**Paper and paperboard**				**Woodpulp**			
	Number of mills		**Annual capacity (% share)**		**Number of mills**		**Annual capacity (% share)**	
	1988	**1980**	**1988**	**1980**	**1988**	**1980**	**1988**	**1980**
0-25	130	205	2.0%	3.7%	13	30	0.3%	0.8%
26-50	88	115	3.9	6.0	15	29	0.9	2.0
51-75	67	70	5.0	6.2	13	19	1.2	2.2
76-100	39	42	4.1	5.2	11	17	1.5	2.8
101-125	29	43	3.9	6.9	14	12	2.5	2.5
126-150	29	16	4.9	3.2	11	9	2.3	2.7
151-175	9	15	1.8	3.7	7	14	1.8	4.2
176-200	16	20	3.6	5.6	6	10	1.8	3.8
201-250	32	23	8.7	7.7	23	19	7.9	7.5
251-300	20	13	6.8	5.0	17	17	7.2	8.0
301-350	11	15	4.5	6.9	7	7	3.6	4.7
351-400	11	18	5.0	9.5	12	13	7.1	8.8
401-450	10	12	5.2	7.2	11	13	7.3	9.9
451-500	13	8	7.3	5.3	15	14	11.3	12.0
Over 500	40	20	33.3	18.0	40	25	43.3	28.1
Total	544	635	100.0	100.0	215	248	100.0	100.0

Source: American Paper Institute.

United States:

PRODUCTION, EXPORTS, AND IMPORTS

Growth in paper and paperboard production slowed in 1989 after three strong years but picked up again in 1990. If output continued at the rate shown through the first half, the industry would produce 77.8 million tons by year end—1.5% above 1989 levels, according to figures from the American Paper Institute. The seasonally adjusted annual rate for paper production was 39.1 million tons, up 2.5% from 1989's total, and paperboard production was up 0.5% to 38.7 million tons.

The economy has been cooling since 1987-88, flattening out paper and board production and consumption. Real GNP grew about 1.3% in first-quarter 1990 and 2.8% in the second quarter, and it was expected to expand 1.9% for the year. Inventory buildup throughout the economy helped to shore up GNP. For the pulp, paper, and board industry in particular, inventories at the end of June were 8% above year-earlier figures.

Paper production growth in the first half of 1990 was led by newsprint, which surged 8.9% above mid-year tallies in 1989. Even so, newsprint supplies were relatively tight, with customers holding high inventories as a buffer against strikes and with some production possibly going into nonnewspaper applications. Among printing and writing grades—which rose 2.8% overall—thin paper did best, jumping 6.1%. Uncoated free-sheet shipments increased 2.4%, and coated paper shipments rose 3.5%. Coated groundwood grades suffered from diminished magazine advertising, as automotive, tobacco, and computer markets weakened. Tissue grew 2.4%. Unbleached kraft paper did the worst, plunging 10.5%. Commodity kraft paper was hurt by production curtailments and weakened demand, as some consumers turned to plastic bags and some end-users' markets softened.

Paperboard production in 1990 did not reach the extremes shown by paper, varying instead from 2.4% growth vs first-half 1989 in unbleached kraft linerboard, to -5.9% in other unbleached kraft paperboard. Recycled paperboard slipped 1.2%. Much of the growth in the paperboard sector was due to production of kraft grades for export, API noted.

U.S. woodpulp manufacturing rose just 1.2% to 26.2 million tons in the first five months of 1990 compared with the same period the previous year. Groundwood and thermomechanical grades did best, racking up a 6.6% advance, while dissolving and special alpha pulps performed least well, dropping off 8.1%.

Paper and board exports—though not strictly comparable to 1989 figures—were up 9.1% in the first five months of 1990 and heading for an annual rate of 5.8 milion tons. Paper exports rose 5.0% in that period, while the more dominant board exports did more than twice as well, jumping 10.7%. Printing and writing grades led the rise, spearheaded by a 127% hike in uncoated free-sheet exports. Woodpulp exports in the first five months sank 8.7%, for an annual rate of 5.7 million tons.

Imports were up 4.2% through May 1990, aiming for an annual rate of 12.8 million tons. Paper accounted for the vast majority of those shipments, principally newsprint, uncoated groundwood, and coated printing and impregnated paper. Woodpulp imports were down less than 1% in the first five months, for an annual rate of 5.1 million tons.

Exports from the U.S. to Canada of paper and board bounded up 41.3% in the first five months vs 1989, with the major printing and writing and paperboard sectors doing well. If shipments to Canada continue at that rate, the exports will total 0.9 million tons for 1990.

U.S. paper and board imports from Canada rose a modest 6.0% through May 1990 compared with the same period the previous year, for an annualized rate of 11.2 million tons. Shipments of printing and writing grades were up significantly, but newsprint—by far the principal sector—held fairly steady. That could change with four new newsprint machines due online in Canada in first-half 1991. Woodpulp imports from Canada were up just 2.2% at an annual rate of 4.6 million tons. Canadian pulp producers were taking heavy downtime to work off inventories and to try to support prices.

HISTORICAL PRODUCTION TRENDS

Paper and paperboard production grew fairly steadily after the recession in the mid-1970s, topping out at 61.3 million tons in 1979 and then turning down in the recession year of 1980. While production jumped 1.8% in 1981, another recession began toward the end of the year. That pushed production in the following year to its lowest level since 1978, down 4.5% to 59.5 million tons.

The rebound that followed in 1983 brought production up 9.3% to a record 65.0 million tons, 4.4% above the previous record of 62.3 million tons two years before. Then in 1984, output rose a further 5.4% to 68.5 million tons, though business slacked off in the last quarter. As growth slowed and the dollar strengthened in the next year—making exports expensive overseas and imports cheap in the U.S.—production dropped 2.2% to 67.0 million tons.

In the third quarter of 1985, the dollar began its long drop against many world currencies, a trend that continued through 1987. In response to strengthening domestic demand, particularly among consumers, paper and board production jumped up 5.8% to 70.9 million tons in 1986.

Corrugated box shipments increased by 6%, and folding cartons by 4%, reflecting strong gains in market segments such as appliance and television production. And the printing/writing paper sector showed gains of 6.8% in shipments in response to higher printing activity and increased demand for office papers.

Performance was strong again in 1987, with production rising 4.8% to 74.3 million tons, buoyed by a 9.5% spurt in coated paper shipments and a 7.8% hike in unbleached kraft linerboard production. Offices used more copy paper, envelopes, and computer printout, and printing paper benefited from growth in direct mail. Uncoated free-sheet shipments bumped up 5.3%, while newsprint production grew 3.8% to a record 5.8 million tons.

A third set of record highs characterized 1988. Production growth slowed but still managed to reach 76.5 million

U.S. PAPER AND BOARD PRODUCTION BY MAJOR GRADE, 1985-89

	(000 short tons)					(Percent change)				
	1989	1988	1987	1986	1985	1989/88	1988/87	1987/86	1986/85	1985/84
Paper										
Newsprint	6,088	5,982	5,842	5,630	5,428	1.8	2.4	3.8	3.7	-2.0
Printing/writing	21,540	21,857	20,778	19,668	18,423	-1.5	5.2	5.6	6.8	0.0
Uncoated groundwood (s)	1,754	1,624	1,498	1,540	1,521	8.0	8.4	-2.7	1.2	-2.8
Coated paper (s)	7,194	7,359	6,860	6,263	5,875	-2.2	7.3	9.5	6.6	-6.0
Uncoated free-sheet (s)	11,043	11,277	10,966	10,410	9,690	-2.1	2.8	5.3	7.4	5.9
Thin paper	245	281	240	271	262	-12.8	17.1	-11.4	3.4	-13.5
Cotton fiber (s)	157	167	163	152	144	-6.0	2.5	7.2	5.6	-2.0
Bleached bristol (s)	1,148	1,150	1,052	1,033	970	-0.2	9.3	1.8	6.5	-3.3
Tissue paper	5,636	5,476	5,301	5,095	4,941	2.9	3.3	4.0	3.1	0.0
Packaging and industrial converting (s)	4,925	5,047	4,955	5,117	5,204	-2.4	1.9	-3.2	-1.7	-6.8
Unbleached kraft paper (s)	2,681	2,800	2,840	3,303	3,403	-4.3	-1.4	-14.0	-2.9	-7.6
Other paper	2,243	2,247	2,115	1,814	1,801	-0.2	6.2	16.6	0.7	-5.3
Total paper	38,189	38,363	36,876	35,510	34,036	-0.5	4.0	3.8	4.3	-1.2
Paperboard										
Unbleached kraft linerboard	18,206	17,897	17,683	16,402	15,183	1.7	1.2	7.8	8.0	-5.3
Other unbleached kraft paperboard	1,284	1,243	1,215	1,287	1,184	3.3	2.3	-5.6	8.7	3.0
Semichemical paperboard	5,691	5,664	5,536	5,376	5,088	0.5	2.3	3.0	5.7	-1.6
Solid bleached	4,521	4,511	4,406	4,222	3,948	0.2	2.4	4.4	6.9	-2.5
Recycled	8,754	8,788	8,601	8,092	7,630	-0.4	2.2	6.3	6.1	-0.1
Total paperboard	38,456	38,103	37,442	35,379	33,034	0.9	1.8	5.8	7.1	-3.0
Total paper and paperboard	76,646	76,466	74,318	70,889	67,070	0.2	2.9	4.8	5.7	-2.1
Construction and wet machine	n.a.	n.a.	1,600	1,600	1,700	—	—	—	-5.9	-5.6
Total	n.a.	n.a.	75,918	72,489	68,770	—	—	4.7	5.4	-2.2

n.a. = Not available.
(s) = Shipments.
Note: Data may not add to totals because of rounding.
Source: American Paper Institute

tons, an increase of 2.9%. And market pulp output grew 5.6% to 8.6 million tons. The October 1987 stock market crash put jitters in the industry but was not followed by a recession. On the contrary, the economy grew 4.4% in 1988.

The printing/writing sector put on a 5.2% hike that year, aided by demand among magazine publishers and commercial printers who brought about a 7.3% rise in coated paper output. The paperboard sector did not do so well, rising just 1.8% in 1988, though production of solid bleached grades rose 2.4%. And unbleached kraft linerboard grew just 1.2% after two years of strong growth. U.S. fiber box shipments grew 3.2%, and production of containerboard for the U.S. climbed 2.2%.

After three years of strong growth and record output, paper and paperboard production flattened in 1989, rising only slightly to 76.6 million tons, according to API figures. Paper production was 38.2 million tpy—less than 1% below a year earlier. Paperboard output was 38.5 million tpy—up 1% from 1988.

Last year, paper and paperboard production lagged behind the general economy, which has cooled since 1988 yet still grew 3.0% in 1989. Paper inventory reductions helped flatten output in the first half of 1989, but production picked up in the second half, with corrections in printing/writing grade inventories essentially complete. And despite the slowdown, the industry is not expected to repeat the slump of the early 1980s.

Paper firms put a record $15 billion into new paper machines and related process equipment in 1989, helping to bring operating rates down 2% to 93%.

Tissue paper came through with the strongest production performance among major sectors in 1989, growing 2.9%. In the printing/writing sector, which dropped 1.5% overall, uncoated groundwood production did best, with a jump of 8.0%, but thin paper was dismal, falling 12.8%. Uncoated free-sheet, which dipped 2.1%, suffered from major expansions, price cuts, and the aftereffects of panic buying in the midst of continuous price hikes earlier in the 1980s. Coated paper also faced low operating rates in 1989 as a result of new capacity. Paperboard was more consistently positive

U.S. WOODPULP PRODUCTION BY MAJOR GRADES, 1983-89

(000 short tons)

	1989	1988	1987	1986	1985	1984	1983
Woodpulp							
Bleached sulfite	n.a.	1,365	1,269	1,275	1,364	1,359	1,306
Unbleached sulfite	n.a.	195	171	164	196	259	310
Total sulfite	1,567	1,560	1,440	1,439	1,560	1,618	1,616
Bleached and semibleached sulfate	26,979	26,302	25,411	24,158	22,626	22,350	21,107
Unbleached sulfate	21,648	21,631	21,442	20,481	19,510	20,721	19,590
Total white pulp* (bleached sulfite + bleached and semibleached sulfate)	28,546	27,667	26,680	25,433	23,990	23,709	22,413
Total chemical paper-grade (total sulfite + bleached and semibleached sulfate + unbleached sulfate	50,194	49,493	48,293	46,078	43,696	44,689	42,313
Semichemical	4,370	4,358	4,246	4,191	4,026	4,069	3,812
Mechanical	6,032	5,943	5,702	5,476	5,251	5,506	5,067
Total paper-grade	60,596	59,794	58,241	55,745	52,973	54,264	51,192
Dissolving, special alpha	1,427	1,367	1,312	1,257	1,174	1,206	1,261
Total woodpulp	62,023	61,161	59,553	57,002	54,147	55,470	52,453
Market pulp							
Chemical paper-grade	7,242	7,200	6,806	6,316	5,613	5,680	5,255
Groundwood, other	0	0	0	5	15	15	12
Dissolving	1,422	1,365	1,308	1,251	1,172	1,204	1,260
Total market pulp	8,664	8,565	8,114	7,572	6,800	6,899	6,527
Operating rates (%)							
Total white pulp	99.7	99.0	98.5	97.5	95.6	99.6	98.8
Total paper-grade	96.5	97.3	97.4	95.5	88.9	92.0	88.9
Dissolving/special alpha	95.5	94.3	94.5	89.8	80.7	81.1	82.7

*Includes small amount of unbleached sulfite after 1988.
n.a. = Not available.
Source: American Paper Institute.

than paper, led by growth of 3.3% in unbleached kraft paperboard, excluding linerboard.

EXPORTS

U.S. exports rise and fall with exchange rates. When the dollar reached a low relative to other major currencies in 1980, pulp and paper exports—including wastepaper and converted products—hit 11.8 million tons, an explosive increase of 31.9%.

But a rising dollar began to take its toll in 1981, and though the value of exports rose 1.4%, volume dropped 9.9%. In the following recessionary year, export value plunged 11.9% as prices dropped, the dollar strengthened, and volume sank 7.4%.

Prices rose and the currency remained strong in 1983, so in that year, shipment value was off 2.2%. But exports responded to more vigorous demand and grew 10.3%.

In 1984, although the increasing might of the dollar held back industry performance, strong overseas demand pushed up exports 14.7% to 12.3 million tons. Action in the different sectors was uneven to say the least, including a 70.4% surge in wastepaper shipments and a drop in paperboard exports of 6.7%. Pulp exports shrank 1.4%. Overall, the value of shipments for paper, board, and converted products rose 7.2%.

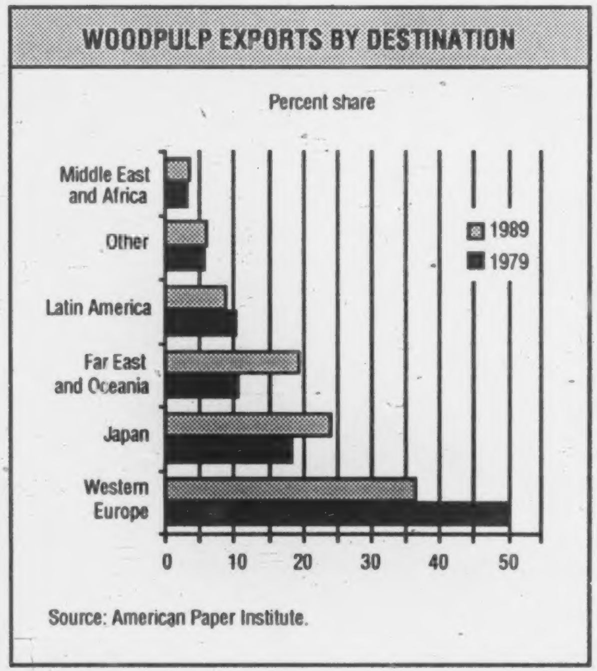
The dollar hit a high against other currencies in 1985, and world markets also softened,

OPERATING RATES FOR MAJOR GRADE SEGMENTS

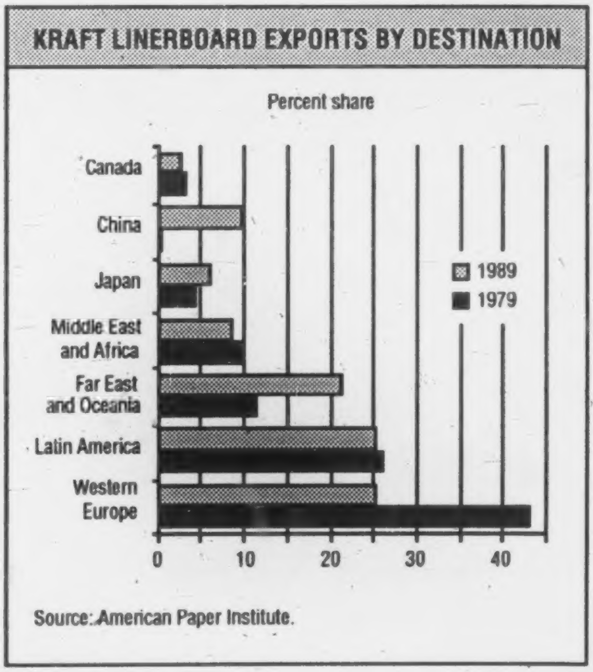
(Production or shipments/annual capacity)

	1989	1988	1987	1986	1985
Paper					
Newsprint	96.9%	97.8%	97.3%	97.0%	93.8%
Printing/writing (s)	90.5	94.9	94.1	93.5	90.0
Tissue	97.8	96.6	96.3	93.1	92.4
Packaging/industrial converting (s)	90.0	93.4	92.4	88.9	87.0
Total paper	92.4	95.4	94.7	93.3	90.5
Paperboard					
Unbleached kraft	93.4	94.4	97.3	94.8	90.2
Semichemical	96.2	97.9	97.5	96.7	94.0
Solid bleached	95.7	95.3	93.1	93.3	90.3
Recycled	91.1	92.2	92.8	89.7	86.8
Total paperboard	93.5	94.5	95.8	93.8	90.0
Total paper and paperboard	93.0	94.9	95.2	93.5	90.2

(s) = Shipments.
Source: American Paper Institute.



Source: American Paper Institute.



Source: American Paper Institute.

drawing down export volume 3.4% and value by 10.7%.

Relief occurred in 1986, when demand reappeared and the currency began to slide down, eventually settling in 1987 at about half its 1985 rate. This proved a boon to U.S. suppliers, shoring up 1986 exports 9.1% to 12.9 million tons and bouncing their value up 16.2%. Kraft linerboard dominated paperboard exports, which grew a whopping 21.8%. Pulp showed a respectable 17.5% increase, though wastepaper sagged 7.9%.

The following year, as weakness in the dollar continued, exports grew another 12.1% to 14.8 million tons, and record prices brought shipment value up 27.8%. Wastepaper rebounded, up 18.0%, pulp exports rose 9.7%, and paperboard improved 6.7%.

In spite of a more robust currency starting in second-quarter 1988, exports of paper and paperboard hit a record 4.7 mil[illegible] tons for a rise of 6.1%. Value of those shipments grew 18.4% to $2.6 billion. Woodpulp performed particularly well, with exports of a record 5.5 million tons accounting for a 29.0% hike in value to $2.9 billion.

Paper also did well, with volume growing 19.7% over 1987 figures to 1.1 million tons and value jumping 27.0% to $988 million. Newsprint was the most significant export grade; it also performed best among paper segments by

HISTORICAL U.S. PAPER AND BOARD PRODUCTION, CAPACITY, AND OPERATING RATES, 1960-89

(000 short tons)

	Production				Capacity		Operating rate
Year	Paper	Paperboard	Total paper/board[1]	Change (%)	Total paper/board[1]	Change (%)	Total paper/board
1989	38,189	38,456	76,645	0.2%	82,444	2.4%	93.0
1988	38,363	38,103	76,466	2.9	80,533	3.0	94.9
1987	36,876	37,442	74,318	4.8	78,186	3.2	95.1
1986	35,510	35,379	70,889	5.9	75,777	2.0	93.5
1985	34,036	32,922	66,958	-2.2	74,301	1.6	90.1
1984	34,466	34,002	68,468	5.4	73,098	2.8	93.7
1983	32,816	32,145	64,961	9.6	71,126	1.5	91.3
1982	30,252	29,044	59,296	-4.5	70,086	2.8	84.6
1981	30,901	31,208	62,109	1.7	68,172	2.7	91.1
1980	30,116	30,926	61,042	0.0	66,368	2.7	92.0
1979	29,666	31,404	61,070	4.3	64,615	2.4	94.5
1978	28,320	30,252	58,572	3.4	63,091	1.8	92.8
1977	27,721	28,935	56,656	3.0	62,004	1.1	91.4
1976	26,577	28,415	54,992	14.6	61,307	1.9	89.7
1975	23,260	24,737	47,997	-13.9	60,140	1.0	79.8
1974	26,863	28,894	55,757	-1.0	59,527	2.3	93.7
1973	26,797	29,550	56,347	4.7	58,164	4.1	96.9
1972	25,359	28,484	53,843	8.2	55,873	3.2	96.4
1971	23,722	26,019	49,741	2.1	54,136	1.6	91.9
1970	23,351	25,367	48,718	-2.2	53,260	0.3	91.5
1969	23,449	26,362	49,811	5.8	53,094	3.8	93.8
1968	22,181	24,890	47,071	7.6	51,147	4.7	92.0
1967	20,926	22,819	43,745	-0.4	48,850	4.8	89.5
1966	20,725	23,179	43,904	8.4	46,608	7.1	94.2
1965	19,157	21,332	40,489	6.4	43,535	4.6	93.0
1964	18,112	19,954	38,066	6.0	41,623	3.7	91.5
1963	17,320	18,594	35,914	4.4	40,143	3.4	89.5
1962	16,560	17,847	34,407	5.7	38,810	1.3	88.7
1961	15,821	16,727	32,548	4.3	38,299	4.0	85.0
1960	15,295	15,926	31,221	15.4	36,840	3.1	84.7
Average annual change	1980-89			2.4		2.5	
	1970-79			2.3		2.0	
	1960-69			6.4		4.0	

1. Excludes hard pressed board, construction paper and board, and wet machine board.
Source: American Paper Institute.

growing 25.6%. Shipments in the sector hit 427,000 tons. Paperboard exports in 1988 did not do as well, however. Lower shipments of containerboard and recycled board held the sector down to 3.6 million tons—a 2.5% increase.

Paper and paperboard exports set yet another record in 1989, rising 10.1% to 5.2 million tons, with a solid increase in value of 12.8% to $3.0 billion. The dollar peaked mid-year, but a weakening economy pushed it back down.

Paper shipments abroad put in a strong performance, expanding 33% to 1.5 million tons, while the value of these exports rose 24.9% to $1.2 billion. Much of that increase was due to newsprint and printing/writing grades, while tissue and packaging/industrial paper shipments out of the U.S. slackened. Printing and writing grades put in a stellar performance, jumping 66.6% and growing in value 48.6%.

Paperboard shipments of 3.8 million tons outpaced 1988 performance by a mere 3.2%, and value growth of 5.5% to $1.7 billion was not much better. Kraft linerboard exports shot up, but recycled paperboard held the sector back.

HISTORICAL U.S. WOODPULP PRODUCTION, CAPACITY, AND OPERATING RATES

(000 short tons)

Year	Production Total*	Production Captive	Production Market	Total* capacity	Operating rate
1989	61,998	53,334	8,664	64,284	96.4
1988	61,161	52,596	8,565	62,946	97.2
1987	59,552	51,438	8,114	61,166	97.4
1986	57,002	49,429	7,573	59,743	95.4
1985	54,147	47,347	6,800	58,612	92.4
1984	55,471	48,572	6,899	57,713	96.1
1983	52,454	45,928	6,526	56,112	93.5
1982	49,334	43,602	5,732	56,091	88.0
1981	52,042	45,839	6,203	54,833	94.9
1980	50,734	44,269	6,465	53,154	95.4
1979	49,366	44,688	4,678	51,574	95.7
1978	46,888	41,726	5,162	49,723	94.3
1977	46,648	41,828	4,820	49,839	93.6
1976	45,385	40,515	4,870	48,681	93.2
1975	40,584	36,240	4,344	46,575	87.1

*Includes paper-grade, dissolving/special alpha pulps but excludes defibrated/exploded pulps, screenings, and fiber other than wood.
Source: American Paper Institute.

TOP PRODUCING STATES IN 1987

(000 short tons)

Pulp		Paper		Paperboard	
Georgia	6,887	Wisconsin	4,266	Georgia	4,802
Alabama	6,397	Maine	3,252	Alabama	3,125
Louisiana	4,970	Washington	2,678	Louisiana	2,980
Washington	4,531	Alabama	2,541	Florida	2,096
Florida	3,710	Louisiana	1,935	Oregon	1,983
Texas	3,123	Pennsylvania	1,835	Virginia	1,858
North Carolina	3,112	New York	1,688	South Carolina	1,847
Oregon	3,070	Oregon	1,568	California	1,389
South Carolina	2,949	Michigan	1,555	Michigan	1,381
Virginia	2,897	Georgia	1,505	Tennessee	1,280

Note: Production figures for several top-producing states are excluded by the Dept. of Commerce to avoid revealing data for individual companies, biasing the above list against states with a small number of major producers. Such states include Texas, Mississippi, and South Carolina.
Source: Bureau of the Census.

Pulp exports of 6.2 million tons reflected growth of 12.7%, outpaced by value growth of 20.5% to $3.5 billion, due principally to price increases.

IMPORTS

Exchange rates appear to have a different effect on imports than they do on exports. Unlike exports, imports rose dramatically as the dollar strengthened from 1983-85 and then kept growing even when the currency retreated. One factor has been the European producers' reluctance to relinquish their U.S. market position in spite of the shift in the nation's currency. And the Canadian dollar has been even weaker than the declining U.S. dollar, contributing to some of the robustness of the import market.

Imports from Canada will grow 6% in 1990. Canada dominates the U.S. import scene and will supply about 87% of foreign shipments sent to the U.S. in 1990.

Canadian shipments account for 87% of U.S. paper imports and 84% of board imports. In the newsprint sector, Canada overwhelms the competition by providing 98% of U.S. imports. While that is still a 58% share of U.S. consumption, the U.S. has become more self-sufficient in newsprint. In 1950, for example, that share was up around 80%, and it dropped to 63% in 1970. Canada also accounts for 90% of the country's pulp imports, or 7% of U.S. consumption. And the U.S.'s northern neighbor accounts for 63% of both tissue and printing and writing grade imports.

Canada and the U.S., the two largest trading partners in the world, have agreed on a binational trade agreement that will eliminate tariffs for numerous paper and paperboard grades by 1993. Tariffs on these designated products will be cut in five, equal annual stages.

Back in 1983, the strong dollar and healthy economy pushed up imports of paper, board, pulp, and converted products 12.1% to 12.7 million tons. And in 1984, imports jumped another 19.5% to 15.2 million tons. The printing/writing sector exploded, rising 51% in 1983 and reaching 2 million tons after a 78% boom the following year.

In the newsprint and market pulp import sectors, Canada dominates the scene. And in 1984, it boosted newsprint shipments to the U.S. 9.1% and pulp shipments 8.0%. Overseas producers also paid more attention to the U.S. market during this period, and their interest pushed overall newsprint imports up 14.1% and pulp imports up 9.7%.

In 1985, the market cooled off somewhat, bringing imports up just 3.2%, including a 5.2% hike in paper imports. Printing/writing papers dropped off 6.4%, though activity in this sector was still high by historical standards. The dollar remained strong, which was a benefit to producers outside North America though it was no help for domestic manufacturers. While domestic demand for coated paper was strong, for example, a flood of European imports prevented U.S. manufacturers from raising prices.

Late in the year, the dollar dropped off, though imports still rose 4.0% in 1986. Printing/writing papers rebounded and grew 6.1%; pulp imports posted a 2.6% rise, with Canadian pulp shipments to the U.S. growing 3.1%.

The dollar weakened further in 1987, while imports improved another 7.5%. Strong demand among commercial printers allowed European exporters to keep up shipments of printing/writing papers. Canada supplied half of the imports of this grade, as the Canadian dollar continued to weaken with respect to U.S. currency. This helped to push up its printing/writing shipments to the U.S. by 18.8%, and Canadian newsprint shipments grew 5.2%.

The next year witnessed an 18.7% increase in printing/

INVENTORY LEVELS FOR PULP, NEWSPRINT, AND CONTAINERBOARD

Year	Norscan producer pulp stocks[1]	U.S. consumer newsprint stocks[2]		U.S. containerboard inventories[3]	
	(000 metric tons)	(000 metric tons)	(days)	(000 short tons)	(weeks)
1990					
June	1,397	1,308	41	2,503	5.3
Mar.	1,392	1,256	37	2,626	5.8
1989					
Dec.	1,021	1,204	38	2,501	5.7
Sept.	994	1,324	37	2,642	5.6
June	773	1,300	42	2,475	5.5
Mar.	760	1,426	41	2,569	5.7
1988					
Dec.	666	1,469	46	2,487	5.3
Sept.	767	1,626	44	2,732	6.2
June	670	1,544	49	2,595	5.9
Mar.	805	1,512	44	2,589	5.8
1987					
Dec.	691	1,411	45	2,396	5.3
Sept.	856	1,509	41	2,437	5.5
June	795	1,405	44	2,383	5.6
Mar.	867	1,367	40	2,391	5.4
Year end					
1986	870	1,268	42	2,134	5.3
1985	1,329	1,394	46	2,469	6.6
1984	1,619	1,329	45	2,442	7.1
1983	1,207	1,179	42	2,415	6.5
1982	1,603	1,258	47	2,524	7.6
1981	1,430	1,477	56	2,729	9.4
1980	949	1,090	42	1,984	6.2
1979	616	877	34	1,979	6.2
1978	903	971	38	1,961	5.8
1977	2,083	1,071	43	2,437	7.2
1976	2,825	1,209	52	2,527	8.1
1975	2,011	911	44	2,185	7.2
1974	611	1,061	48	2,323	8.2
1973	629	757	32	1,595	4.7
1972	1,149	667	26	1,603	5.1
1971	1,618	885	38	1,639	5.7
1970	647	944	42	1,879	7.0
Year-end averages					
1980-89	1,139	1,308	45	2,408	6.5
1970-79	1,309	935	40	2,013	6.5

1. Chemical paper-grade market pulp stocks at North American/Scandinavian producer mills (source: American Paper Institute).
2. Estimated U.S. publisher stocks of newsprint and days of supply (source: Canadian Pulp & Paper Assn.).
3. Containerboard inventories at box plants and mills and weeks of supply (source: Fibre Box Assn.).

writing papers to 2.9 million tons as domestic demand continued strong, though newsprint imports dropped 2.1% to 8.8 million tons. The largest suppliers of the printing/writing grades were Canada and Finland, with a concentration on uncoated groundwood and clay-coated papers.

Total paper and paperboard imports reached 12.4 million tons after an increase of 2.3% over 1987. Those shipments were worth $6.9 billion, reflecting a healthy 17.6% boost. Woodpulp import value alone grew 28.7% to $2.7 billion, carried by 5.0 million tons.

Strong European demand and a low dollar redirected the attention of overseas producers to their own markets. And as the value of the Canadian dollar moved up, Canadian producers—whose exports to the U.S. are priced in U.S. dollars—also shifted to other markets.

As the domestic market in the U.S. weakened some, paper and paperboard imports dropped off 0.5% in 1989, settling at 12.3 million tons; but at a value of $7.2 billion they were worth 3.6% more than in 1988.

Just as printing/writing and newsprint grades were responsible for much of the increase in paper exports, they are responsible for much of the decrease in imports. In the printing/writing sector, API noted that shipments from Canada displaced those from overseas. Newsprint—the largest import sector—suffered from softening markets and higher domestic output. Paperboard imports, on the other hand,

U.S. PAPER INDUSTRY EXPORTS, IMPORTS, AND NET TRADE BALANCE

	1989		1988		1987		1979	
	Tons (000)	Value (million $)	Tons (000)	Value (million $)	Tons (000)	Value (million $)	Tons (000)	Value (million $)
Exports								
Woodpulp	6,231	3,513	5,528	2,915	4,889	2,259	2,935	1,104
Paper	1,466	1,234	1,102	988	921	777	601	507
Newsprint	625	357	427	295	340	210	71	32
Printing/writing	478	465	287	313	249	243	275	233
Packaging and industrial	342	381	347	342	294	293	227	218
Tissue	21	30	41	37	38	31	28	24
Paperboard	3,758	1,734	3,642	1,644	3,551	1,445	2,447	791
Kraft linerboard	2,500	935	2,281	888	2,297	812	1,645	435
Other unbleached kraft paperboard	247	113	292	103	211	79	100	34
Semichemical medium	31	14	42	18	64	23	17	5
Bleached packaging paperboard	795	583	743	503	648	408	509	239
Recycled paperboard	185	88	283	133	331	123	176	78
Total paper/paperboard	5,224	2,968	4,745	2,632	4,472	2,222	3,048	1,298
Converted products	1,040	1,278	815	1,051	725	823	562	586
Construction and wet machine	36	15	132	69	107	59	62	31
Wastepaper	5,981	730	5,640	688	4,422	553	2,233	256
Cotton pulp and other fiber	122	101	202	112	182	91	131	75
Total industry exports	18,634	8,604	17,061	7,467	14,797	6,007	8,971	3,350
Imports								
Woodpulp	5,005	2,981	5,038	2,663	4,850	2,069	4,318	1,465
Paper	11,814	6,901	12,064	6,799	11,765	5,768	8,560	2,896
Newsprint	8,553	4,380	8,802	4,570	8,987	4,121	7,223	2,300
Printing/writing	2,733	1,996	2,860	1,949	2,410	1,412	1,179	512
Packaging and industrial	407	414	343	232	310	192	141	74
Tissue	121	111	60	48	58	43	17	10
Total paperboard	533	280	341	131	361	127	82	19
Total paper/paperboard	12,348	7,181	12,405	6,930	12,126	5,895	8,642	2,915
Converted products	562	1,098	383	964	402	933	96	223
Construction and wet machine	190	50	322	108	309	99	385	70
Wastepaper	173	33	161	27	127	19	78	11
Total industry imports	18,289	11,352	18,309	10,692	17,814	9,015	13,519	4,684
Net trade balance (deficit)								
Woodpulp	1,226	532	490	252	39	190	(1,383)	(361)
Paper/paperboard	(7,124)	(4,213)	(7,660)	(4,298)	(7,654)	(3,673)	(5,594)	(1,617)
Total industry	345	(2,748)	(1,248)	(3,225)	(3,017)	(3,008)	(4,548)	(1,334)

Sources: American Paper Institute, Dept. of Commerce.

spurted up 56% to 533,000 tons in 1989.

Woodpulp imports dropped 0.7% to 5.0 million tons. While shipments from Canada to the U.S. increased slightly, imports from overseas dropped quite a bit.

HISTORICAL U.S. PAPER AND PAPERBOARD PRODUCTION, IMPORTS, EXPORTS, AND APPARENT CONSUMPTION, 1950-89

Year	Production[1] (000 tons)	Imports[1] (000 tons)	Exports[1] (000 tons)	Apparent consumption[2] (000 tons)	Real GNP (billion 1982 $)	Ratio consumption to real GNP (000 tons/ billion $)	Population (million)	Per capita consumption (lb/capita)
1989	76,646	12,910	6,263	83,293	4,144.0	20.10	248.2	671.2
1988	76,466	12,788	5,559	83,695	4,024.0	20.80	245.8	681.0
1987	74,318	12,528	5,197	81,649	3,854.0	21.19	243.4	670.9
1986	70,875	11,597	4,593	77,879	3,718.0	20.95	241.1	646.0
1985	66,958	11,105	4,003	74,060	3,618.7	20.47	239.3	619.0
1984	68,468	10,576	4,310	74,734	3,501.4	21.34	237.0	630.7
1983	64,961	8,509	4,502	68,968	3,279.1	21.03	234.8	587.5
1982	59,296	7,603	4,187	62,712	3,166.0	19.81	232.5	539.5
1981	62,109	7,941	4,561	65,489	3,248.7	20.16	230.1	569.2
1980	61,042	8,304	5,148	64,198	3,187.2	20.14	227.8	563.6
1979	61,071	8,738	3,610	66,199	3,192.4	20.74	225.1	588.2
1978	58,571	8,781	3,301	64,051	3,115.2	20.56	222.6	575.5
1977	56,656	7,294	3,171	60,779	2,958.6	20.54	220.2	552.0
1976	54,993	7,042	3,388	58,647	2,826.7	20.75	218.0	538.0
1975	47,997	6,164	3,050	51,111	2,695.0	18.97	216.0	473.3
1974	55,756	7,970	3,720	60,006	2,729.3	21.99	213.9	561.1
1973	56,346	8,019	2,965	61,400	2,744.0	22.38	211.9	579.5
1972	53,842	7,567	3,019	58,390	2,608.5	22.38	209.9	556.4
1971	49,742	7,319	3,076	53,985	2,484.8	21.73	207.7	519.8
1970	48,719	7,057	2,780	52,996	2,416.2	21.93	205.1	516.8
1969	49,810	7,210	2,702	54,318	2,423.3	22.41	202.7	535.9
1968	47,071	6,792	2,587	51,276	2,365.6	21.68	200.7	511.0
1967	43,745	6,916	2,053	48,608	2,271.3	21.40	198.7	489.3
1966	43,904	7,327	1,903	49,328	2,208.3	22.34	196.6	501.8
1965	40,489	6,549	1,736	45,302	2,087.6	21.70	194.3	466.3
1964	38,066	6,154	1,661	42,559	1,973.3	21.57	191.9	443.6
1963	35,914	5,637	1,302	40,249	1,873.3	21.49	189.2	425.5
1962	34,407	5,719	1,154	38,972	1,799.4	21.66	186.5	417.9
1961	32,548	5,663	1,175	37,036	1,708.7	21.67	183.7	403.2
1960	31,221	5,610	990	35,841	1,665.2	21.52	180.7	396.7
1955	26,772	5,313	805	31,280	1,485.2	21.06	165.9	377.1
1950	21,563	4,973	337	26,199	1,210.3	21.65	152.3	344.0

1. Excludes wet machine board, construction paper and board, and hard pressed board.
2. Apparent consumption (new supply) = production + imports - exports.
Sources: American Paper Institute, Dept. of Commerce.

ANTICIPATED SCHEDULE OF TARIFF REDUCTIONS FOR SELECTED GRADES, 1988-93

	1993	1992	1991	1990	1989	1988
Canadian tariffs on imports from U.S.						
Printing papers						
cut to size	0.0%	1.6%	3.2%	4.8%	6.4%	8.0%
not cut to size	0.0	1.3	2.6	3.9	5.2	6.5
Writing papers	0.0	1.3	2.6	3.9	5.2	6.5
Coated groundwood	0.0	0.5	1.0	1.5	2.0	2.5
Recycled boxboard	0.0	1.8	3.6	5.4	7.2	9.2
Linerboard	0.0	1.3	2.6	3.9	5.2	6.5
Solid bleached board	0.0	1.3	2.6	3.9	5.2	6.5
Corrugating medium	0.0	0.8	1.6	2.4	3.2	4.0
Unbleached kraft paper	0.0	0.8	1.6	2.4	3.2	4.0
Bleached wrapping papers	0.0	1.8	3.6	5.4	7.2	9.2
Sanitary papers (rolls)	0.0	1.3	2.6	3.9	5.2	6.5
cut to size	0.0	2.0	4.0	6.0	8.0	10.2
Folding cartons	0.0	2.0	4.0	6.0	8.0	10.2
Corrugated boxes	0.0	1.8	3.6	5.4	7.2	9.2
Paper bags	0.0	1.8	3.6	5.4	7.2	9.2
U.S. tariffs on imports from Canada						
Bristols, drawing	0.0%	0.4%	0.7%	1.0%	1.3%	1.6%
Carbonizing paper						
15 g/m^2 and under	0.0	0.5	1.0	1.5	2.0	2.6
over 15 g/m^2	0.0	0.4	0.8	1.2	1.6	2.0
Cover, writing	0.0	0.4	0.9	1.4	1.9	2.4
India, bible papers						
less than 40 g/m^2	0.0	0.4	0.7	1.0	1.3	1.6
40 to 150 g/m^2	0.0	0.2	0.6	1.0	1.4	1.8
Coated printing papers						
woodfree	0.0	0.5	1.0	1.5	2.0	2.5
groundwood, LWC	0.0	0.5	1.0	1.5	2.0	2.5
Sulfite wrapping	0.0	0.4	0.9	1.4	1.9	2.4
Corrugating medium	0.0	0.8	1.6	2.4	3.2	4.0
Packaged sanitary	0.0	1.3	2.3	3.3	4.3	5.3

Source: Canadian Pulp & Paper Assn.

United States:

PRICES

Paper, paperboard, and converted products prices tend to decline in recessions and to rise strongly in economic recoveries. Fiber prices are even more volatile, with wastepaper often leading economic cycles and woodpulp lagging them.

Pulp and paper prices rose sluggishly during the first half of the 1980s as a result of back-to-back recessions early in the decade and the U.S. dollar's strength in 1984 and 1985. The strong dollar attracted more paper imports into U.S. markets and made it increasingly difficult for U.S. and Canadian mills to export market pulp and paperboard. The dollar's impact on pulp, paper, and board prices was as severe as any recession. In 1985, prices for paper rose only 0.2% from the previous year, according to the Dept. of Commerce's Bureau of Labor Statistics (BLS). Paperboard prices declined 4.8%, and woodpulp prices plunged 12.6%.

The subsequent slide in the dollar's value between 1986 and 1989 had exactly the opposite effect. The woodpulp price index shot up 20.0% between January 1986 and January 1987, followed by a further 14.3% boost between January 1987 and January 1988. Over the two-year period, paperboard prices jumped by more than 17%, while paper prices rose 12%.

New records were posted for several grades in 1987, and these were exceeded again in 1988 as demand strengthened and the dollar drifted downward. In 1987, the woodpulp index rose 17.7%, wastepaper climbed 27.7%, paperboard prices rose 10.8%, and paper grades posted a 4.2% increase. In 1988, the woodpulp index jumped 22.6%, while wastepaper inched up another 1.2%. Paperboard prices for the year were up 12.8%, and paper grades posted a 10.5% advance. In 1989, the dollar gained strength but then receded, and it is expected to continue to weaken in 1990. Woodpulp prices rose 15.2% in 1989, and both paper grades and paperboard went up 5.2%. Wastepaper tabs, on the other hand, dropped off 14.4%.

The index for pulp, paper, and converted products has grown slightly more than the overall producer price index in the 1980s. Prices have risen 5.2%/year on average for pulp, paper, and converted products vs 4.1%/year for all industrial commodities. Over the long term, however, paper industry prices have kept closer pace with the overall index, rising an average of 6.7%/year since 1970 vs 6.4%/year for industrial commodities.

PULP

Pulp prices are highly cyclical and tend to lag fluctuations in the world economy by as much as two years. One reason is that integrated producers are usually net buyers of pulp during strong markets but net sellers during times of weakness, causing sharp swings in supply and demand. Other factors include producer inventory levels, operating rates, and changes in average manufacturing costs. Historically, pulp prices have risen when the ratio of shipments to capacity reaches 87% to 88% and when North American and Scandinavian producer inventories have dropped to about 1.2 million metric tons. Exchange rate fluctuations have also had an impact on pulp prices, which are quoted mainly in U.S. dollars.

Pulp prices did not fare well for the first half of the 1980s. The BLS index for woodpulp climbed just 4.5%/year during the 1980-87 period, far below the 14.0% annual growth of the 1970s. The picture improved with significant jumps of 17.7% and 22.6% in 1987 and 1988, respectively, and in 1989, pulp tabs grew another 15.2%. These hikes brought the average annual rate for the 1980s to 7.3%.

Following a decade of stability during the 1960s, pulp pricing changed drastically in the 1970s as a result of growing market tightness and a sharp escalation in production costs—particularly for energy and wood—in the 1973-74 and 1978-80 periods. In the 1978 downturn, the list price for benchmark northern bleached softwood kraft (NBSK) reached a low of $330/metric ton (delivered in U.S.). It then rose for eight consecutive quarters, hitting $530/ton in 1980. This represented a 61% rise from the 1978 trough.

Subsequent attempts to raise prices proved unsuccessful, however. The official $545/metric ton (c.i.f., northern Europe) list price that had been in effect for two years broke in the second quarter of 1982 and plummeted to $400 to $410/ton by first-quarter 1983. This 26% decline was even worse than the 1977-78 drop. Exchange rates played a major role in the decline, as the strong dollar undermined pulp prices by giving Scandinavian and nontraditional producers a cost advantage, allowing them to cut prices to add market share. At the same time, the strong dollar made pulp more expensive for buyers with weak currencies, who became more resistant to increases. While the U.S. dollar price dropped 26% from 1980 to 1982, the price of pulp in pounds sterling, lire, and francs actually rose about 8%, and the deutsche mark price declined by 11%.

Pulp prices firmed only slightly in 1983, but a labor dispute in British Columbia sparked a recovery to $540/metric ton for NBSK in Europe during the first half of 1984. However, overproduction later in the year coupled with a large bulge of new capacity drove the price back down to a low of about $390/ton by early 1985.

Chemical paper-grade pulp prices climbed four consecutive quarters in 1986 as the U.S. dollar weakened and as demand strengthened. The declining dollar reversed the cost advantage of Scandinavian producers and made price increases easy to swallow for overseas customers. NBSK prices rose to $520/metric ton during the last quarter of 1986—a 33% increase for U.S. customers, but only 3% in Japan and 4% in Fed. Rep. Germany.

Producers followed up with price hikes in each quarter of 1987 and 1988 and in the first two quarters of 1989. These brought the price of NBSK in Europe to $840/metric ton by second-quarter 1989—roughly twice what it fetched in 1980. Producers managed to linger within about $10 of that price level through mid-1990. But the industry's united front finally cracked under pressure from significantly cheaper southern pulp, and in July, some manufacturers dropped NBSK to $800/metric ton in most major world markets. Increasing capacity is expected to push tabs down even further.

PAPER

Paper weathered the last recession better than other industry products, but prices have suffered in recent years from overcapacity in key printing/writing grades. The BLS

PRICE INDEXES FOR U.S. PULP, PAPER, AND PRODUCTS VS ALL INDUSTRIAL COMMODITIES

(1982 = 100)

Year	Industrial commodities	Pulp, paper, and products*	Woodpulp	Wastepaper	Paper	Paper-board	Converted products
1989	111.6	132.4	157.5	157.1	129.6	140.1	131.7
% change	5.0%	6.1%	15.2%	–14.4%	5.2%	5.2%	7.1%
1988	106.3	124.8	136.7	183.6	123.2	133.2	123.0
% change	3.6%	9.2%	22.6%	1.2%	10.5%	12.8%	7.2%
1987	102.6	114.3	111.5	181.4	111.5	118.1	114.7
% change	2.6%	6.2%	17.7%	27.2%	4.2%	10.8%	4.8%
1986	100.0	107.6	94.7	142.6	107.0	106.6	109.4
1985	103.7	106.9	91.4	122.9	106.0	107.7	108.9
1984	103.3	107.3	104.8	198.2	105.8	110.4	106.4
1983	101.1	99.3	91.5	115.0	98.5	98.4	100.4
1982	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1981	97.4	99.1	104.8	145.0	97.7	101.2	97.9
1980	88.0	91.7	100.3	172.2	89.7	92.0	90.2
1979	75.7	80.6	82.9	170.5	80.2	79.3	79.4
1978	67.0	71.6	70.3	157.8	72.0	70.5	70.5
1977	62.5	68.6	74.2	154.6	67.8	69.1	66.8
1976	58.4	66.2	75.5	152.6	63.7	69.1	64.3
1975	54.9	62.9	74.8	90.9	60.4	66.8	61.2
1974	49.2	55.9	57.5	219.2	51.9	59.7	54.8
1973	40.3	44.8	33.8	162.9	42.4	45.2	46.0
1972	37.8	41.6	29.4	110.3	40.6	41.4	43.0
1971	36.5	40.4	29.6	92.5	39.9	40.2	41.5
1970	35.2	39.7	28.9	103.2	38.8	39.7	40.8
Average annual rate 1970-88	6.4%	6.7%	10.6%	7.7%	6.7%	7.2%	6.5%

* Excludes construction grades.
Source: Bureau of Labor Statistics.

price index for paper grades rose an average of 5.0%/year during the 1980-89 period, compared with 8.6% annual growth in the 1970s.

Newsprint. In October 1982, newsprint prices fell for the first time since the Great Depression, dropping from the $500/metric-ton list price established in the U.S. East market in mid-1981 to $468/ton. Overcapacity forced the drop-off, while competition from other publications grades (also selling for less because of overcapacity) made already-soft markets worse. The economic recovery boosted consumption, allowing producers to push the list price back up to $500/ton in mid-1983, but transaction prices did not firm to that level until the ten-week British Columbian shutdown in the first quarter of 1984.

Another price hike later in the year brought newsprint to a list of $535/metric ton, but slower growth and publisher inventory building combined to thwart an attempted increase in January 1985. Mills tried to raise prices another six times in 1985, but all of these attempts failed. Discounting increased as markets remained soft and as imports of cheap offshore newsprint picked up.

Gradually improving demand helped markets firm up in 1986, and producers were finally able to push through a price hike in October to a list of $570/metric ton, although the increase was not implemented fully until early 1987. Markets continued to strengthen throughout 1987, and producers were able to increase prices on July 1 by $40 to $610/ton. This was followed on Jan. 1, 1988, by another hike of $40, increasing the cost to $650/ton.

Transaction prices continued to be significantly below list during this time, ranging between $570 and $610/metric ton at the beginning of 1988. This proved to be the peak of the latest cycle for newsprint producers, who saw market prices erode in 1988 to an average transaction level of $600/ton, followed by an additional $30/ton drop in first-half 1989 due to sluggish demand and to anticipated capacity additions through 1990. By late 1989, average transaction prices for newsprint delivered to U.S. East markets had dropped to $535/metric ton, compared with a $650 list. In the West, prices averaged $540/metric ton in the new year.

Shrinking inventories, the threat of possible strikes in Canada, downtime, delays in new machine startups, and increased European demand then firmed the market to such an extent that producers managed to push through a June 1990 price hike of $35/metric ton in the East to $685, and a rise of $31.50 in the West to $630. Transaction prices in both regions averaged $570/metric ton.

Coated paper. Heavy demand kept the coated groundwood industry running virtually flat out in the late 1970s, allowing a steady series of price increases after the 1974-75 recession. However, a heavy influx of new capacity and lower demand caused prices to flatten in 1981 and 1982, forcing a price rollback in early 1983. Demand quickly outpaced new capacity as the recovery picked up steam, allowing producers to restore prices and push through two increases in 1984. Demand for coated free-sheet was almost as strong, and mills were able to raise prices in fourth-quarter 1983, in January 1984, and again in second-quarter 1984.

Coated groundwood producers raised prices again in early 1985, but the combination of fewer orders and import pressure sent prices back to late-1984 levels by early 1986. Overcapacity struck both free-sheet and groundwood grades later that year, although strong demand growth helped cushion the effects, especially for premium grades. By early 1987, both sectors were forced to roll back prices.

That distressing market situation turned around quickly at the end of the second quarter, with help from the conversion of some groundwood tonnage to free-sheet and from the temporary production of uncoated papers by a few producers. A price increase of $50 to $70/short ton was implemented successfully in July for coated groundwood grades, and demand continued to soar through the end of 1987. That strength continued in 1988, with prices moving up 6% for No. 4 coated (50 lb, in rolls) and nearly 20% for No. 1 coated (70 lb).

Discounting crept into the picture by early 1989, however. A July 1 hike that would have boosted list levels by an average of 5% had to be rescinded. The weak market kept pricing competitive throughout the year and led to delays of new coated groundwood machines. While the fourth quarter was somewhat more upbeat, this did not carry through into 1990. Discounts early in the year on coated groundwood grades were around 4% to 6%, and No. 3 (60 lb) was at $1,120 to $1,140. By mid-year, manufacturers had decided not to try a price hike in the face of weak demand from the advertising market and new coated free-sheet capacity. In July, discounting on coated groundwood continued at a routine $40 to $60/ton.

North American coated mills announced that they might file dumping complaints against some European producers, charging that some paper from the U.K. and Scandinavia was being sold in North America for $200/ton less than in Europe and $30 to $40/ton below typical North American tabs.

Uncoated free-sheet. Uncoated free-sheet prices came under heavy pressure during the recession, with deep cuts in prices for all but the premium grades. As with coated papers, however, the booming recovery allowed producers to regain lost ground. Prices went up in the last quarter of 1983 and again in the following quarter.

Cheap imports and a spurt of new capacity toward the end of the year undercut prices during 1984. By the end of the year, 50-lb offset was down as low as $560/short ton, where it remained until prices in general began to improve in mid-1985. As 1985 progressed, prices firmed across the spectrum of uncoated free-sheet, and in April and July of 1986, producers raised them. Demand was strong enough to support the price increases despite overcapacity caused by completion of several major expansion projects.

In the first half of 1987, that new capacity came back to haunt producers, as prices plummeted in the face of weakened demand. An attempted price hike failed at the end of the first quarter, sending prices back to late-1986 levels with sales typically about $80/short ton below list. Overcapacity and competitive price cutting delayed another increase until Sept. 1, by which time markets had tightened considerably, thanks in part to labor problems. Throughout

SELECTED U.S. PULP, PAPER, AND CONVERTED PRODUCT PRICES

	$/short ton domestic market—unless otherwise indicated					Percentage change from year earlier			
	4th Q 1989	4th Q 1988	4th Q 1987	4th Q 1986	4th Q 1985	4th Q 1989	4th Q 1988	4th Q 1987	4th Q 1986
PULP ($/metric ton)									
Bleached softwood kraft—northern	$830	$760	$610	$480/520	$400*	9.2	24.6	22.0	25.0
Bleached softwood kraft—southern	800	735/740	585	490	360	8.4	26.1	19.4	36.1
Bleached hardwood kraft—southern	735	685/695	565	460	320*	6.5	22.1	22.8	43.8
PAPER									
Newsprint (30-lb East)	(535-540)*	(544)*	(517)	454/499*	485*	-1.1	5.2	8.5	-1.8
Directory (22.5-lb white)	(730)/780	850	720	670	670	-11.2	18.1	7.5	n.c.
Coated publication paper									
No. 1 (+70-lb sheets)	1,610/1,640*	1,560/1,600	1,440/1,460	1,375*	1,375*	2.8	9.0	5.5	n.c.
No. 5 (34-lb rolls)	(960)/990	990/1,000	890	860*	931*	-2.0	11.8	3.5	-7.6
Uncoated free-sheet									
Book paper (No. 3 offset, +45-lb sheets)	(940)/1,020	1,020	850	850	800	-3.9	20.0	n.c.	6.3
No. 1 (watermarked, +20-lb sheets)	1,090/1,100	1,090/1,100	960	985	985	n.c.	14.1	-2.5	n.c.
Forms bond (15-lb rolls)	(800-860)/910	(880)/910	760	720	600	-2.8	17.8	5.6	20.0
Tissue (BLS index)	130.8	117.1	114.3	109.7	104.7	11.7	2.4	4.2	4.8
Unbleached kraft shipping sack (+50 lb)	550/560	510/520	480/490	(420/430)	360/375*	7.8	6.2	14.1	15.6
PAPERBOARD									
Unbleached kraft linerboard (42-lb East)	410*	410	380	320	250/260	n.c.	7.9	18.8	25.5
Semichemical medium (26-lb East)	(360/370)	(390)/400	350/360	290/300	240	-7.6	11.3	20.3	22.9
Folding boxboard									
Clay-coated recycled (20-pt rolls)	480/510	440/460	390/430	380/420	350/400	10.0	9.8	2.5	6.7
Solid bleached sulfate (15 pt, C1S, 80 brite, rolls)	830/840	720/740	625/660	570/625	500/590	14.4	13.6	7.5	9.6
CONSTRUCTION GRADES									
Building paper & board (BLS index)	116.8	112.8	113.6	109.9	106.3	3.5	-0.7	3.0	3.4
CONVERTED PRODUCTS									
Corrugated price trend (FBA index)	282.4	283.6	267.4	236.0	227.2	-0.4	6.1	13.3	3.9

*Discounting below list prices.
( ) = Estimated transaction prices where most volume is moving significantly below list.
n.c. = No change.
Sources: *Pulp & Paper Week*, Bureau of Labor Statistics, Fibre Box Assn.

most of 1988, mills were able to pass along one or more price increases. For example, 50-lb offset (rolls) shot up by 17% between Jan. 1, 1988, and a year later; however, the $900/ton list stagnated during the first six months of 1988, while discounting escalated to as much as $160/ton. By mid-1989, it was apparent that the market was slowing for virtually all uncoated free-sheet sectors. Even grades previously on allocation, such as cut-size repro, were loosening up. By July, prices were off as much as 20%, reflecting slowing demand, new capacity, and inventory work-off.

Producers raised prices early in 1989, though transaction prices would still be below the highs of 1987 and 1988. Forms bond manufacturers tried to raise prices $40/ton in an attempt to bring transaction prices closer to list prices. On 15-lb forms, for example, the transaction price was about $860/ton before the hike, compared with a $910 list. Cut-size reprographic and offset producers followed suit in April. By mid-year, cut-size tabs stood at $840 to $860/ton, and offset in the Southeast ranged from $850 list down to $800 with discounts. Machine downtime helped; however, four uncoated free-sheet machines are expected online by 1992.

Brown paper. Unbleached kraft paper has been the weakest segment in recent years, particularly the heavier-weight grades, which are subject to competitive pressure from swing linerboard machines producing kraft papers during slow periods. Prices for 70-lb grocery sack paper fell from a prerecession peak of about $310/short ton to a discounted $240/ton in late 1982. Multiwall kraft sack paper also suffered during the downturn, due to weakness in key markets such as construction and agriculture. Prices picked up along with the economy in 1983, as swing machines returned to linerboard production and as inventories dropped to normal levels.

With mills running full, producers were able to push through sharp run-ups in some grades. Grocery sack prices surpassed prerecession levels in early 1984, but another increase to bring prices into parity with lightweight linerboard by early summer never fully took effect. A $30/short-ton first-quarter increase for multiwall sack paper prices also failed to take hold, as agricultural and construction markets remained sluggish.

Grocery bag and sack paper prices began to deteriorate in late 1984 as the linerboard market softened, and multiwall shipping sack paper prices also weakened further. By spring 1985, renewed swing production on linerboard machines had pushed the price of 70-lb grocery sack paper down to $260/short ton or less. By summer, some multiwall paper was discounted to $360/ton and lower.

Closure of several kraft paper machines tightened the supply/demand balance beginning in mid-1985, and producers responded with a steady stream of increases on grocery bag and sack grades. As demand stayed strong, loss of market share to plastics was the only constraint on prices. Grocery bag and sack paper prices rose in September 1985, and producers pushed through successive increases in January, April, and October 1986, as well as in February 1987. Multiwall sack paper prices also climbed, with increases during the first and third quarters of 1986 and the first quarter of 1987.

The February 1987 increases brought 70-lb prices to about $400/short ton (the same as lightweight linerboard); prices for 50-lb multiwall paper rose to $450 to $460/ton. Markets stayed very tight into 1987, and kraft paper producers successfully implemented a $30/ton price increase for most grades in September, again on the heels of a linerboard increase. The increase raised 70-lb grocery sack paper to $425 to $435/ton; 50-lb multiwall rose to $480 to $490/ton.

A year later, prices climbed an additional 6% to 7% or more, with 70-lb unbleached kraft paper selling for $455 to $465/short ton and 50-lb shipping sack selling for $510 to $520/ton by Oct. 1, 1988. Another hike was implemented in first-quarter 1989, raising prices about $40/ton across the board, and they remained fairly stable through the rest of the year.

Early in 1990, grocery sack was selling as low as $430/ton for 70-lb on the West Coast but at $495 and above in the East. Multiwall paper was at $530 to $550 for 50-lb. Weaker demand and increased competition from Pacific Rim producers prompted Canadian manufacturers to ship more to the U.S. But maintenance shutdowns and increased swing-machine production of linerboard helped prices stay steady through mid-1990. Demand was expected to remain constant for the rest of the year.

PAPERBOARD

Paperboard prices have climbed an average of 6.1%/year during the 1980s, down from an 8.4%/year rate in the previous decade. Hurt by the strong dollar, prices on average declined 4.8% in 1985 and another 1.2% in 1986. Prices bounced back in 1987, however, rising 10.8% because of strong domestic demand and a weaker dollar. This was followed by an additional 12.8% boost in 1988 and 5.2% the following year.

Containerboard. Both linerboard and corrugating medium suffered sharp drops during the recession, with 42-lb linerboard prices falling from $300/short ton in early 1981 to $250/ton and lower by late 1982. Corrugating medium took a similar plunge. Prices began climbing again in 1983, but producers were unable to regain old levels until a February 1984 hike to $320/ton.

An increase to $350/short ton attempted in the fall of 1984 only partly took hold because of increasing pressure on the market from the strong U.S. dollar. Containerboard prices began to erode in early 1985, and by summer, linerboard was down to $250 to $260/ton, where it stayed for the rest of the year.

Markets tightened in late 1985 due to healthy box demand, a surge in export shipments, and production curtailments. Linerboard prices made a strong recovery in 1986, with the base price of 42-lb board rising from $260/short ton and below in the first quarter to $320/ton by the third quarter. Strong export demand aided by the dollar's decline was a big factor in the upturn. Producers easily pushed through a $30/ton hike in January 1987, returning list levels to their peak of fall 1984. Two other increases later in 1987 raised 42-lb linerboard to $410/ton before zoned discounts. However, a price hike of $40/ton in the first quarter of 1989 had to be rescinded due to weakening demand as the economy stagnated and box makers resisted the increase. The linerboard market was balanced through mid-year, though discounts of $10 to $20 were fairly common in the Northeast.

In spite of strong exports, 42-lb linerboard tabs dropped to $380/ton in first-quarter 1990 in the East. Expansion downtime helped to stabilize the grade at that level into the second quarter, but by mid-year, the price was off another $10 to $20. And with the slow season coming up and more than 2 million tons of kraft linerboard capacity coming online during 1990-92, the future did not look too bright.

Prices for semichemical medium have generally followed the pattern for linerboard, though the differential between both has been a wide $30 to $40/short ton since at least 1988. In second-quarter 1989, 26-lb semichemical medium sold for $380 to $390/ton. Part of the problem was increased competition from Canadian suppliers, a result of the Free Trade Agreement lowering tariffs, plus increased availability of recycled board at prices of about $350/ton.

By the fourth quarter, semichemical corrugating medium was selling for about $350/ton in the Northeast, $360 to $370 in the Midwest, and $10 higher than that on the West Coast. And those tabs slipped to $330 to $350 by second-quarter 1990 in the Northeast, and $310 by the summer, though West Coast prices were $340 to $360. Recycled medium dropped to $290 to $300—close to break-even for some producers.

In Europe, U.S. producers successfully pushed through a $35/metric ton increase on heavyweight board in the fall of 1986, raising prices to $405/ton before duties. Similar increases were successful in March and August of 1987. The $40/ton increase in August brought heavyweight linerboard in Europe to $480/ton c.i.f. in most markets, while the list for lightweight linerboard in Southeast Asia rose to $515 to $530/ton, depending on the country.

Gradual weakening in the U.S. domestic market in 1988 caused transaction prices offshore to drop to levels as low as $420 to $430/ton in some markets. By mid-1989 linerboard prices in many export markets were $20 to $30 below domestic price levels and almost twice that one quarter later as a result of too much U.S. capacity. As a result, exports dropped off. Average prices for exports from southern mills were around $330 to $350/ton f.a.s. in November as a result of apparently unbased expectations of a weaker market. U.S. export prices in northern Europe for heavyweight linerboard were around $440 to $460/ton c.i.f. early in 1990. And first-quarter tabs for linerboard in Southeast Asia stabilized at about $470 to $500 after dropping $30/ton in the previous quarter. These levels held in Europe through mid-1990, and Southeast Asian markets firmed somewhat.

Boxboard. Although more recession-proof than other grades because of various end uses in food packaging, solid bleached folding boxboard prices also fell in 1982 This occurred partly because of competition from clay-coated recycled boxboard mills benefiting from the sharp decline in wastepaper prices. In 1983, some producers tried to return to the $625/short-ton list, but the attempt failed. Markets moved up sharply during the last half of 1984, only to erode in 1985. On the recycled side, chipboard prices remained relatively firm during the 1984-85 downturn, but clay-coated board prices were down to the $300/ton range in some spot sales by 1985.

Bleached board prices began to firm up in the first quarter of 1986. Producers raised lists about $30/short ton and began to cut back on discounts. A second round of hikes was successful in the third quarter, but a third attempt at the end of the year failed to gain support. After trying and generally failing to raise prices all year, recycled producers got some relief from high wastepaper prices with a fourth-quarter increase in all areas of the country except the West Coast.

After some initial difficulty, producers raised bleached board prices again in the spring of 1987, bringing folding carton stock prices up $30/short ton to a new list of about $645/ton. West Coast recycled board producers also pushed through a price hike—their first in over two years. Bleached board producers took advantage of a pickup in business in late summer to announce another increase of about $35/ton, effective in the fall. At the same time, recycled boxboard producers in the Midwest implemented price hikes, raising transaction prices to $390 to $430/ton for most business.

In 1988, bleached board producers increased prices by $40/short ton in April and by $55/ton in September, raising the price of 15-pt board to $730/ton by year end. This was followed by two $50/ton hikes in January and August 1989, which raised the list to $830/ton.

Recycled board producers were equally aggressive in 1988, raising prices of folding carton stock three times. Prices for 20-pt clay-coated board increased about $100/short ton to $500/ton by year end. The momentum did not carry over into 1989, however. But as 1990 approached, producers announced a rise in clay-coated recycled folding boxboard of $35/ton.

A slowing economy and customer inventory reductions caused manufacturers to scale back bleached folding carton stock production in first-quarter 1990. Prices of $830 to $840/ton for 15-pt clay-coated folding carton grades were temporarily discounted $30 in the spring, though many bounced back by mid-year, when the inventory work-down appeared to be complete. Strong demand from consumer goods manufacturers firmed recycled tabs.

Wastepaper. Wastepaper prices are the most volatile in the paper industry, fluctuating wildly in response to supply and demand. The average annual growth rate for the 1980-88 period was 3.4%, compared with 12.4% during the 1970s. Prices dropped 16% in 1981 and another 31% in 1982, according to BLS data. A 15% increase in 1983 was followed by the largest gain of the decade—72% in 1984. Wastepaper prices plummeted 38% in 1985 before rising 16% in 1986 and 28% in 1987. In 1988, the cycle began to change again, and the BLS wastepaper price index moved up just 1.2%. The following year, the index was down 14.4%.

CONVERTED PRODUCTS

Converted products prices have been more stable than primary grades, holding up better during the recession but missing out on the strong recovery afterward. Prices have risen an average of 5.3%/year since 1980, down from 7.8%/year in the 1970s. That is somewhat better than the performance of paper, though not as good as paperboard, indicating that some converters have been unable to entirely pass on raw materials price increases and maintain profit margins over the long term.

Converted products price indexes outperformed paper and board in the recession years, rising 2.1% in 1982 and 0.4% in 1983. However, converters did not keep pace with increases on paper and paperboard in 1984, as converted prices climbed only 6.0%, compared with 15.1% for paperboard and 7.4% for paper. Converters again kept pace with their suppliers during the sluggish 1985-86 period, but since then, prices have fluctuated for converted products in comparison with paper and board. The converted products price index for 1988 was up only 7.2% from the previous year, compared with a 12.8% increase for paperboard, suggesting some renewed and substantial pressure on converters' profit margins. The following year, they recovered some of that by raising prices 7.1% vs paper and board producers' more modest 5.2% hike.

Corrugated box prices tend to follow domestic swings in containerboard prices as converters try to pass on higher input costs. Containerboard accounts for about 50% to 55% of the cost of producing a corrugated box. Converter profit margins fattened in 1985, when containerboard prices fell nearly 30% and box prices fell only about 12%. Since then, however, box prices have failed to match the steep run-up in containerboard prices. After several failed attempts, converters pushed through an 8% increase in the third quarter of 1986. After the January 1987 containerboard price hike, integrated box makers got another 10% increase in box prices in the spring. This returned box prices to near their previous historic high. Under pressure from higher containerboard prices, box makers were fairly successful in pushing through an 8% increase in September. Corrugated box end users saw their box costs rise nearly 9% in 1988 after an 11.5% rise in 1987. In second-quarter 1989, some producers attempted to push through price hikes of 8% to 10% on corrugated boxes; however, with linerboard prices faltering, these attempts were not fail-safe. And in fact, the index for box prices sank 1.5% by year end. Demand stayed fairly level over the first half of 1990, and new corrugating capacity came onstream, pushing down box prices further and squeezing box makers' margins. But new linerboard capacity coming online over 1990-92 should help to improve those margins.

United States:

PROFITABILITY

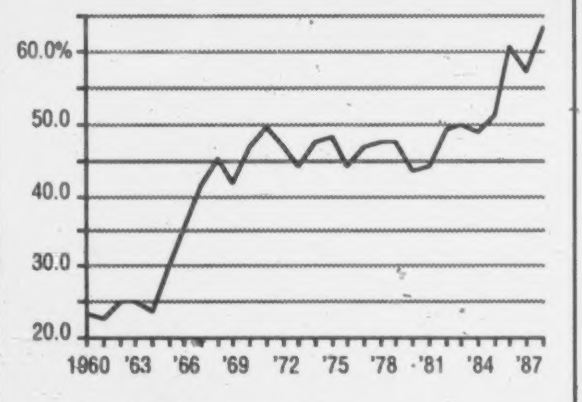
After several years of record earnings, profits went flat in 1989 for the U.S. pulp and paper products industry compared with the previous year. Net earnings were down a scant 0.3% to $7.0 billion on a 11.3% increase in sales to $98.2 billion, based on a *Pulp & Paper Week* survey of financial results from 32 companies. The industry's profit margin sank to 7.1% in 1989, down from 7.5% in 1988, which was the highest level attained since 8.8% in 1950.

The companies surveyed ran up record sales of $98 billion last year, but production remained relatively even at 76.5 million tons, mainly due to customer inventory reductions in printing/writing papers. U.S. paper industry capital spending for new plants and equipment remained strong, rising 36% to $15.4 billion in 1989, with a further increase to $17.[illegible] billion expected in 1990, according to Dept. of Commerce statistics. The industry's 1989 production of paper and paperboard exceeded its output at the start of the decade by 15.6 million tons.

Reflecting the demands of an increasingly information-oriented society, printing and publishing papers accounted for 40% of the decade's growth. "The much ballyhooed proliferation of personal computers stimulated, rather than dampened, the nation's appetite for communications papers," Red Cavaney, President of the American Paper Institute, noted. Kraft linerboard accounted for an additional 24%, responding to the growing need for packaging material in the U.S. and abroad. The U.S. paper industry continued to improve its trade balance last year, with exports of paper and paperboard up 10.8%, while imports declined slightly.

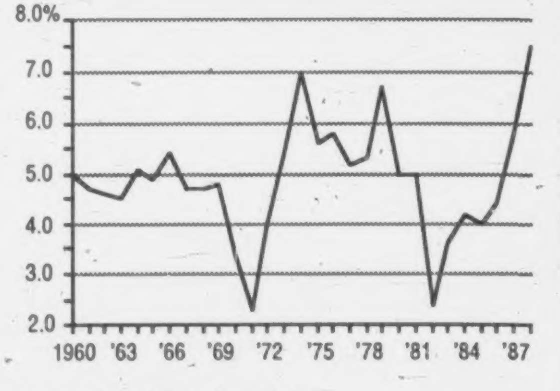
The poor earnings showing last year followed a three-year period of sometimes spectacular growth in earnings,

DEBT TO NET WORTH, 1960-88



Source: Federal Trade Commission.

PROFIT MARGIN, 1960-88



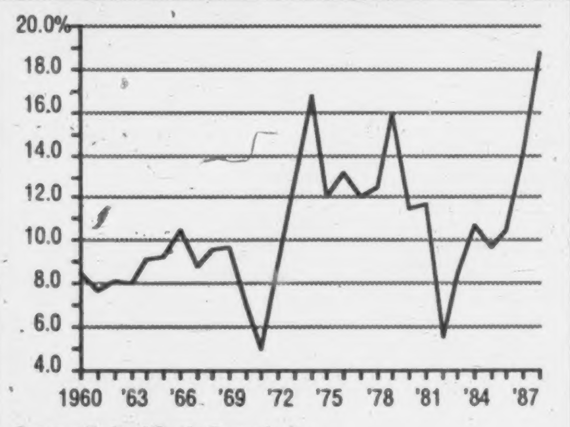
Source: Federal Trade Commission.

with a fourth-quarter 1989 decline being the first negative year-to-year comparison since first-quarter 1986. Industry profits surged by 46.0% in 1987 compared with the previous year. Earnings soared 42.3% in 1988 on a 14.1% increase in sales, and the trend continued into the early part of 1989, with earnings up a healthy 22.0% in the first quarter. But by then it was evident that the momentum was slowing, and a serious downturn was in the works. The decline in fourth-quarter earnings indicated weaknesses in printing/writing grades, market pulp, and especially newsprint. Tissue and boxboard were strong performers throughout 1989, but even linerboard markets began to soften by the end of the year. The lackluster markets may put a damper on capital spending projects slated for 1990.

U.S. pulp and paper companies will spend $18.01 billion on expansion and modernization projects over the 1989-91 period, an increase of 32% over spending in 1988-90. Proposed projects with no firm startup date may add another $5.8 billion, according to *Pulp & Paper* magazine's "Capital Spending Survey: 1989-91." But the projected 1990 industry growth rate of 1.8% is not sufficient to keep U.S. paper mills running near the high capacity rates achieved early in 1989. U.S. papermakers spent nearly $15 billion in 1989 on new production equipment and raised capacity an estimated 2.4% to 82.4 million tons, although output increased less than 1%.

Partly weighing down profits during 1989 were debt loads established in 1988 as the industry financed capital projects and acquisitions. The trend continued through the year, marked by Stone-Container Corp.'s $2.2-billion purchase in March of Canada's Consolidated-Bathurst Inc. and Georgia-Pacific Corp.'s hostile takeover of Great Northern Nekoosa Corp., which was completed in the first quarter of 1990 for $3.4 billion. In the third quarter, Jefferson Smurfit Corp. completed its merger with Container Corp. of America, acquired Tri-Pack Corp., a point-of-purchase display manufacturer, and purchased packaging operations in San Juan, Puerto Rico. U.S. paper companies also increased their stake in European companies in 1989 and early 1990 through acquisitions and joint ventures in anticipation of the European economic merger in 1992.

RETURN ON NET WORTH, 1960-88



Source: Federal Trade Commission.

As in 1988, the U.S. industry continued to enjoy worldwide economic expansion and a favorable U.S. dollar exchange rate in relation to foreign currencies. In 1986-88, the weaker dollar accounted for 70% of the improvement in U.S. paper industry earnings, but in 1989 the dollar's plunge was not enough to offset poor domestic markets. Evidence of a weakening U.S. economy put downward pressure on the dollar, which was good news for U.S. exporters. The dollar rose 15% at mid-year 1989 to its high of DM2.03 and ¥149 on June 14. Then it dropped to DM1.85 and ¥143 by November, while the deutsche mark declined further to about 1.73 in late December. Some analysts expect the dollar to remain weak through 1990 as a result of rising interest rates in Fed. Rep. Germany and Japan.

DOWNTURN IN THE FOURTH QUARTER

Fourth-quarter 1989 earnings fell 4.4% from the final period of 1988, although sales inched up 4.3%. The weather was cited as a major factor in the fourth quarter, with a number of companies reporting mill curtailments due to the deep freeze in December over much of the eastern U.S. Hurricane Hugo and the San Francisco earthquake in October proved to be a boon to wood products shipments, although rain and flooding caused by Hugo was also responsible for driving up pulpwood costs in the southern U.S.

"Strong performances by most of our business through much of the year, combined with the positive impact of acquisitions, produced record sales and earnings," said John A. Georges, chairman and CEO of International Paper Co. The company had the highest sales in the industry in 1989 at $11.4 billion, an 18.8% increase from the previous year. The company posted its sixth year of earnings improvement, with a 14.6% rise in 1989 to $864 million. The specialty business group continued to bolster the company's performance in 1989, accounting for approximately 35% of sales growth and 30% of improvement in earnings, Georges noted.

Georgia-Pacific posted a 41.5% increase in earnings to a record $661 million on a 7% increase in sales to $10.2 billion. G-P chairman and CEO T. Marshall Hahn Jr. attributed a nearly 49% increase in operating earnings from the company's pulp and paper operations to progress in the tissue business, expansions, and the acquisition of Brunswick Pulp & Paper in 1988. Hahn also noted it was a good year for the building products segment. Great Northern Nekoosa's last fiscal year was 1989. Fourth-quarter results plunged 39% as prices weakened and the company fought off G-P's unsolicited offer.

Weyerhaeuser Co. slipped from sales leader in 1988, although it posted record earnings of $601 million on an 8.3% jump in sales to $10.1 billion. But after net charges related to costs associated with divestments of businesses and assets, net earnings totaled only $341 million, a 40% drop from 1988. The company said strength in export markets at the end of the year and a run-up in panel prices in October and November overcame weakness in fine paper markets and maintenance downtime at its pulp and paper mills.

In its fiscal year ending Apr. 29, 1990, James River Corp.'s profits dropped 13%, including a pretax gain of $52 million related to the sale of its Nonwovens Div. in April 1990. The company had pretax charges of $63 million for asset write-offs related to discontinued operations. Boise Cascade Corp. cited weak paper prices and high chip costs in the Pacific Northwest for a 33% drop in the fourth quarter and a 7.5% decline for the full year.

U.S. PAPER AND FOREST PRODUCTS COMPANY SALES AND EARNINGS, 1989

(000 $)

Companies	Sales	Percent change 1989/88	Earnings[1]	Percent change 1989/88
Badger Paper	$74,720	3.6%	$5,321	14.3%
Boise Cascade	4,338,030	5.9	267,580	-7.5
Bowater	1,449,980	2.8	144,569	-12.0
Champion Intl.	5,163,218	0.7	432,421	-5.3
Chesapeake	813,092	14.3	47,640	-7.5
Consolidated Papers	952,521	6.2	167,919	12.0
Federal Paper	1,310,143	17.3	205,480	43.4
Gaylord Container (11/1)	746,000	11.1	39,400	-6.0
Georgia-Pacific	10,171,000	7.0	661,000	41.5
P.H. Glatfelter	598,777	5.2	92,864	12.9
Great Northern Nekoosa	3,863,100	8.3	321,100	-6.0
International Paper	11,400,000	18.8	864,000	14.6
James River (4/29/90)	5,949,987	1.3	221,564	-13.1
Jefferson Smurfit	2,936,285	133.9	35,808	-75.2
Kimberly-Clark	5,733,600	6.3	423,800	11.9
Longview Fibre	697,725	6.2	66,519	-30.9
Louisiana-Pacific *	2,009,500	11.7	192,600	-35.7
Mead *	4,612,100	3.3	215,800	-38.8
Mosinee Paper *	233,114	0.5	6,651	-29.8
Pentair	1,163,627	41.3	36,407	-8.6
Pope & Talbot *	618,758	20.2	43,637	36.6
Potlatch	1,227,622	13.2	136,715	21.7
St. Joe Paper	635,337	-2.3	67,241	-18.7
Scott Paper	5,065,600	7.2	375,500	-6.3
Sonoco Products	1,655,830	3.5	103,561	7.6
Stone Container *	5,330,000	42.4	285,800	-16.4
Temple-Inland *	2,124,000	5.3	207,400	4.1
Union Camp	2,761,337	3.8	299,400	1.4
Wausau (9/31)	317,097	11.6	20,912	30.7
Westvaco (10/31)	2,284,059	7.0	223,090	11.3
Weyerhaeuser *	10,105,610	8.3	601,407	6.3
Willamette	1,891,824	10.2	191,056	18.6
Total	$98,233,593	11.3	$7,004,162	-0.3

1. Income after taxes, from continuing operations, excluding most significant nonrecurring items in both years. Fiscal year ending Dec. 31 unless noted.

***Louisiana-Pacific Corp.**: 1988 income includes gain of $146 million on settlement of Redwood National Park condemnation. **Mead Corp.**: Figures include gains of $15.5 million in 1989 and $112.1 million in 1988 related to the sale of businesses. **Mosinee Paper Corp.**: 1989 income includes charges of $11.3 million primarily from restructuring costs. **Pope & Talbot Inc.**: 1989 income includes $5.5-million gain on sale of a sawmill. **Stone Container Corp.**: 1989 income includes $6-million gain on sale of assets. 1988 income includes gain of $17.3 million related to transfer of 50% ownership of a subsidiary. **Temple-Inland Inc.**: Results include a charge of $800,000 and a gain of $600,000 in 1989 compared with gains of $21 million and $9.7 million in 1988 from property and equipment. **Weyerhaeuser Co.**: 1988 results restated. 1989 income includes charge of $260.3 million.

Source: *Pulp & Paper Week.*

CONTAINERBOARD STUMBLES; TISSUE HOLDS FIRM

Although revenues in 1989 soared 42% to $5.3 billion for Stone Container Corp., profits slipped 16% from 1988 to $286 million. Sales were boosted by the inclusion of Stone-Consolidated Inc., the former Consolidated-Bathhurst of Canada, which was acquired in March. Profits were hurt by price discounting, particularly in newsprint, and a slightly higher tax rate. Corrugated box shipments set a record in 1989, the company said, and containerboard operations ran at near-record levels.

Jefferson Smurfit Corp. completed its merger with Container Corp. of America during the third quarter. During the first nine months of 1989, income was down 5.8%, with sales up 7.3% from 1988. Earnings results from the fourth quarter were not available, but the company took a heavy loss to end the year at $36 million, 75% below the previous year's performance. Sales, however, shot through the roof, with the inclusion of CCA. The company said improvements in the boxboard and folding carton segments were not enough to offset losses in newsprint, containerboard, and reclamation businesses.

Kimberly-Clark Corp. overcame troublesome conditions in its North American pulp and newsprint business with a 12% increase in profits to $424 million. Strong operating results were registered by K-C's personal care and household consumer products businesses, with sales rising 6.3% to $5.7 billion. The company said a lag in its rate of capital spending resulted in less-than-anticipated borrowing, lowering interest expense for the year. But this situation will change in 1990-91, K-C said.

Despite what he called "an outstanding performance" from its tissue business, Scott Paper Co.'s chairman and CEO, Philip E. Lippincott, said financial results in 1989 were "disappointing." Lippincott noted "significant manufacturing difficulties" in the company's printing and publishing paper operations as the reason for the decline as fourth-quarter earnings tumbled 11.5%. Fort Howard Corp. reported a net loss in the fourth quarter of $35 million compared with a net loss of $53 million in the fourth quarter of 1988. Overall, 1989 sales stood at $1.1 billion, while net earnings were minus $239 million. The company was taken private in the second half of 1988 and comparable year-ago results were not available due to a change in accounting.

TROUBLE AHEAD, TROUBLE BEHIND

A *Pulp & Paper Week* survey of Wall Street financial analysts showed that the U.S. economy is likely to continue growing at a modest rate in 1990, with the second half of the year enjoying stronger growth than the first. This sluggish economic trend had already slowed demand and weakened prices for a number of paper and paperboard grades in 1989 and was expected to continue for several more quarters. The weakened dollar was expected to improve the cost-competitiveness of U.S. producers in world markets in 1990 and help sustain U.S. export shipments. When there is a serious supply/demand imbalance, prices for market pulp and other commodity grades tend to fall toward the manufacturing cost level of the higher-cost producers in the world. Manufacturers in such regions as Scandinavia, northern Europe, and Japan would have to take the heaviest downtime to correct any such market imbalance. This would tend to put a higher floor under U.S. dollar pulp prices than was the case in the 1985 market downturn when the dollar was much stronger.

The 1990 forecast called for about a 1.8% increase in GNP growth, a 1.8% gain in paper and paperboard production, a 4.2% decline in industry prices, and a 15.5% drop in paper company profits, though some observers anticipate a much larger decline. Operating rates are forecast to decline to 91.9% for paper and 92.1% for paperboard, which is still in an area where steep price discounting can be avoided. Instead of signaling a headlong plunge into an economic recession, the paper industry trend portends a gradual shift from an inflationary market to a slow deflation.

Uncertainty about the economy has caused both producers and customers to keep inventories for most grades under fairly tight control. In addition, U.S. paper companies have slashed their costs dramatically in recent years, and are now among the most efficient and lowest-cost producers in the world. For 1990 and 1991, the principal concern is that demand growth will lag new supply, leading to lower operating rates and falling prices.

Paper companies are forecast to increase capacity by another 3.1% in 1990, raising total paper and paperboard production to over 85 million tons. Industry operating rates, which are the key barometer of the industry's health, are projected by some analysts to drop below 92% because of the surge of new capacity coming onstream in 1990. "We look for operating rates to decline because the industry is adding capacity faster than likely demand growth," said an analyst with Salomon Brothers. "This means that prices will drop, and the seller's market we've seen over the last few years will come to an end."

The signs of weakness in some paper grades are already evident as a result of supply/demand imbalances. Prices of newsprint fell sharply in 1989 and early 1990, down 15% from the previous year. The projected addition of 2 million tons of North American capacity scheduled for 1989-90 will further erode prices and lead to permanent closures of older, inefficient newsprint mills. Market pulp prices, like newsprint prices, tend to either rise or fall by large amounts. Even with significantly lower prices, however, U.S. producers could still post profit margins of about 20%, although the effect on cash flow would undoubtedly be large.

Price discounting was also widely reported in most grades of coated and uncoated papers and containerboard, especially at the end of 1989. "Many companies will have to be concerned about new and vigorous competition in market pulp, linerboard, and uncoated paper," said Oppenheimer & Co.'s Gary Palmero. The demand for tissue grades should expand in line with planned capacity additions and maintain this segment's high level of operating rates. This will allow producers to endure cost increases and to keep their profit margins intact.

Most of the analysts surveyed agreed that weaker demand, lower prices, and an average cost increase of 4% have dimmed earnings prospects for 1990. The decline in fourth-quarter 1989 was followed by an even sharper drop in the first quarter of 1990 as earnings slipped by about 22% on a 7% increase in sales, according to a preliminary *Pulp & Paper Week* survey of 29 companies. The declining growth reflected spreading price discounts in market pulp, especially northern bleached softwood kraft, softness in printing/writing grades, the depressed newsprint market, and eroding containerboard prices. Tissue and wood products remained the quarter's only bright spots.

The largest earnings declines expected in 1990 are projected for "commodity-oriented" paper companies that produce mainly pulp, newsprint, and containerboard grades, where prices are likely to be more volatile in the future. Even uncoated free-sheet is increasingly becoming a commodity-like paper grade that is subject to wide price swings. Compared with commodity paper producers, the analysts project better earnings for paper companies with strong consumer products and wood products businesses because of strong prices for tissue products, woodchips, lumber, and plywood. The earnings of paper companies that are net purchasers of market pulp will also benefit from the lower pulp prices.

U.S. PAPER AND ALLIED PRODUCTS INDUSTRY FINANCIAL PERFORMANCE, 1960-88

(million $)

					Financial ratios			
Year	Net sales	Percent change from prior year	Net profit after taxes	Percent change from prior year	Profit margins	Return on net worth	Return on total capital	Debt to net worth
1988*	$107,221	12.1	8,081	46.3	7.5	18.8	11.5	63.3
1987*	95,576	27.7	5,520	68.3	5.8	14.1	9.0	57.2
1986*	74,844	4.4	3,280	13.9	4.4	10.5	6.5	60.6
1985*	71,465	-0.2	2,880	-4.1	4.0	9.7	6.4	51.4
1964	71,891	8.8	3,015	29.0	4.2	10.7	7.2	49.0
1983*	65,008	9.6	2,327	60.1	3.6	8.5	5.7	49.8
1982	60,293	-3.5	1,460	-53.0	2.4	5.5	3.7	49.2
1981*	62,699	5.3	3,110	53.0	5.0	11.7	8.1	44.1
1980*	56,250	7.2	2,800	-45.4	5.0	11.5	8.0	43.4
Average 1980-87		7.4		15.2	4.3	10.3	6.8	50.6
1979	55,359	11.4	3,723	40.6	6.7	16.0	10.9	47.5
1978*	48,982	18.5	2,598	18.5	5.3	12.5	8.5	47.6
1977*	45,750	6.8	2,367	-1.6	5.2	12.0	8.2	47.0
1976	39,270	22.6	2,270	26.0	5.8	13.2	9.1	44.3
1975	32,044	4.0	1,801	-17.5	5.6	12.1	8.2	48.3
1974*	32,837	16.2	2,287	51.5	7.0	16.8	11.4	47.5
1973*	26,503	13.6	1,441	53.1	5.4	12.9	8.9	44.2
1972	23,324	4.9	941	83.8	4.0	8.9	6.0	46.8
1971*	22,224	5.5	512	-28.8	2.3	5.0	3.3	49.7
1970	21,069	2.2	719	-27.2	3.4	7.0	4.8	46.8
Average 1970-79		10.6		19.8	5.1	11.6	7.9	47.0
1969	20,607	10.0	987	11.0	4.8	9.7	6.8	41.8
1968	18,738	10.9	889	11.7	4.7	9.6	6.6	45.1
1967*	16,900	-0.7	796	-12.6	4.7	8.8	6.2	41.5
1966	17,016	4.9	911	4.8	5.4	10.5	7.7	35.6
1965*	15,217	9.8	753	15.3	4.9	9.2	7.1	30.0
1964	14,771	5.1	754	18.9	5.1	9.1	7.3	23.7
1963	14,050	2.6	634	1.0	4.5	8.0	6.4	24.9
1962	13,698	9.4	628	7.7	4.6	8.1	6.5	25.1
1961	12,525	6.5	583	-0.7	4.7	7.7	6.2	22.6
1960	11,764	-0.5	587	-5.2	5.0	8.4	6.8	23.3
Average 1960-69		5.8		5.2	4.8	8.9	6.8	31.4

* Revised—change in corporation structure of the industry. Percent changes for sales and profits are computed from data (not shown) consistent with previous year.

Definitions: Profit margins = after-tax net profit to net sales. Return on net worth = after-tax net profit to net worth.

Return on total capital = after-tax profit to net worth + long-term debt. Debt to net worth = long-term debt to net worth.

Sources: Federal Trade Commission, Securities & Exchange Commission, Bureau of the Census. Compiled by American Paper Institute.

PREPARING FOR A SLUMP

Cavaney predicted that the paper industry in 1990 "stands ready to grow at least as fast" as the economy. "Continuing productivity gains and last year's inventory corrections have prepared the U.S. paper industry for the slower economic climate that many are forecasting for 1990," he said.

With warning of an economic downturn, especially for a cyclical industry such as the forest products sector, many companies undertook cost-cutting and restructuring programs to prepare for difficult markets. Despite facing higher costs due to environmental upgrades, energy shortages, and labor contract settlements, as well as lower operating rates, paper industry executives remained optimistic that 1990 and 1991 would not be as bad as originally feared.

Tissue manufacturers especially were preparing for a strong performance, with expansions and recycled projects proliferating in 1989. Prices for sanitary stock stayed a healthy 9% or so above the previous year for most of 1989. But capacity increases are expected to lead to startup difficulties and softening markets. Scott Paper has a total of eight projects coming online in 1990, and the company reported "diminished" confidence for its earnings. But lower pulp prices were expected to be a silver lining to an otherwise cloudy forecast. K-C noted it was looking at a "challenging 24-month period" because of its $2-billion capital-expenditure program. Large projects are slated for completion in late 1990 and 1991, and the company would be impacted with increased interest expense.

"Despite some easing in demand and pricing for some major product lines during the second half of 1989," said International Paper's Georges, "we are confident that our programs to reduce costs, improve quality, increase production of value-added products, and enter new markets will ensure our position as a solidly profitable company in 1990." But as with other commodity-grade manufacturers, Boise Cascade looked warily at conditions for coated and uncoated white papers, very important grades for the company, and also expected less robust conditions for building products in 1990. But even if the the U.S. economy does not slide into recession, forest product prices—especially pulp and newsprint—are expected to come under intense pressure over the next three years.

HISTORICAL PERFORMANCE

U.S. pulp and paper producers especially enjoyed the upturn in their markets in 1986-88 after having endured years of hardship in the early part of the decade. Earnings declined almost 63% between 1980 and 1983 in the worst recession of the postwar period. Federal Trade Commission data show that U.S. paper and allied products earnings fell 53% in 1982 alone, twice the decline of 21% suffered in the 1974-75 downturn and on par with the recession of 1970-71 when profits tumbled 56% over the two-year period.

Profits on the paper side began to evaporate in the fourth quarter of 1981 as weak demand forced sharp price discounting in major grades. Paper company net income declined 8% in 1981 on sales that were up 6% from a year earlier, while forest products companies suffered a 28% drop in earnings for the year. In the depths of the 1982 recession, paper company profits plummeted an additional 47% on sales that were off by 7%, while forest products income plunged 65%.

After six consecutive quarters of decline, paper industry earnings began to show faint signs of recovery in the second quarter of 1983, rising 67% above year-earlier levels. Forest products companies received a much-needed lift from a jump in housing starts and from higher prices for building materials, which boosted profits 73% above 1982 levels. Although lumber prices collapsed in the third quarter due to overcapacity, paper shipments—and prices—improved steadily, and paper products and forest products companies posted increases of 34% and 90%, respectively. As the economic recovery gathered steam late in the year, industry profits took off, rising sixfold among paper companies and almost tenfold for forest products firms. U.S. paper companies finished the year with profits up 45% compared with 1982, while forest products firms enjoyed a 90% increase.

Profits continued to improve dramatically as the economy boomed in early 1984, and several companies set new records for sales and earnings. Paper companies posted a 59% increase in first-quarter net income. Second-quarter figures were even more spectacular as paper company profits jumped 88% compared with the year before on sales that were up 32%. Signs of an economic slowdown began to appear in the third quarter of 1984, however. Paper industry production started to weaken in the fourth quarter, and price discounting began to occur in uncoated free-sheet and in market pulp, reflecting excess capacity and the strong dollar. But industry performance was not hurt too much by these factors, and for 1984 as a whole, earnings jumped 45% on sales that were 15% higher than in 1983.

Overcapacity in some segments and the strong dollar plagued the industry in 1985, causing another downturn in sales and earnings. Ending a year of tough competition and difficult markets, 30 top companies reported earnings down 15% compared with 1984 and sales up a minimal 2%.

Sales and earnings bounced back in 1986, thanks to the steady weakening of the dollar, which began to drop in the fall of 1985. The cheaper dollar helped to firm up export shipments and pricing, which in turn helped the domestic supply/demand balance for many commodity grades and allowed producers to push through some price increases. Cost controls in force at many mills also contributed to improved performance. The first quarter marked the trough of the earnings cycle, as profits dropped another 24% due to continued price weakness in several grade segments. Second-quarter income rose 13%, the first increase since the fourth quarter of 1983, and third-quarter profits soared 30% above the previous year on a sales increase of 5%. For the entire year, earnings climbed a solid 34% over 1985 on sales that improved by 4%. Producers of market pulp, linerboard, and uncoated free-sheet showed the biggest gains.

The upturn continued through 1987, bolstered by favorable economic and market conditions and price increases in most grade segments. A major factor was the decline of the dollar compared with other currencies, and the industry enjoyed full-capacity operation. Profits surged ahead in each of the quarters, ending the year with earnings 45.8% ahead of 1986 on an increase in sales of 19.7%. At the top of the heap was G-P with sales of $8.6 billion. In 1988, weakness began to creep into sectors such as newsprint and wood products but was more than offset by strong pulp and paperboard markets. Profits soared 42% on a 14% increase in sales to $76 billion, with Weyerhaeuser posting the top sales. It was not until second-quarter 1989 that the change in the cycle became apparent in other grades and the industry showed declining profit growth as of the fourth quarter.

FINANCIAL RATIOS

After lagging the average for all manufacturing for two decades, paper industry return on net worth exceeded the average of the 1974-75 tight-market period. Return on net worth reached a peak of 16.8% in 1974, hovered in the 12%-to-13% range from 1975 to 1978, and then hit 16.0% in 1979, according to FTC data. Return on net worth then declined to the 12% level in 1980 and 1981 before plummeting to 5.5% in 1982. Since then, industry return on net worth has been rising on the strength of slowly improving profit margins. The ratio topped 10% in 1984 and 1986, reached 14.1% in 1987, and appeared to have set a new record in 1988 at 18.8%, according to FTC data.

Return on total capital (net worth plus long-term debt) has not kept up with return on net worth, reflecting the heavy debt loads built up by the industry. Long-term debt as a percentage of net worth rose from the low-20% range in the first half of the 1960s to an average of 47% in the 1970s. In 1982, debt to net worth rose to 49% when profits crumbled.

Deterioration in this and other financial ratios caused downgrading of credit ratings for several major producers. Some companies moved to improve their liquidity in the subsequent upswing, but many major producers remain highly leveraged, with some taking on even more debt to finance large acquisitions. FTC data through 1988 show that debt to net worth has continued to climb, topping 51% in 1985 and then soaring to 61% in 1986. It eased slightly to 57% in 1987 but jumped to a new high of 63% in 1988.

United States:

CAPITAL SPENDING

After six consecutive years of record outlays, U.S. pulp and paper companies have trimmed their capital spending plans for 1990 and beyond in the face of deteriorating profits and sluggish growth. Companies have invested heavily over the past several years to expand capacity, cut costs, improve product quality, and meet environmental standards, but the spending boom appears likely to peak in 1990.

Solid evidence for a slowdown began to appear early in the year as companies lowered their 1990 capital plans. In late 1989, the industry reported plans to spend $17.92 billion on capital projects in 1990, according to the Bureau of Census. In April 1990, however, that figure had fallen by about $200 million, or 1.1%, from the earlier forecast. A downward revision of 5.1% in planned outlays for the second quarter was responsible for the decline. Further downward revisions are likely this year as the industry responds to slower growth in demand, excess capacity in some grade segments, and reduced profitability.

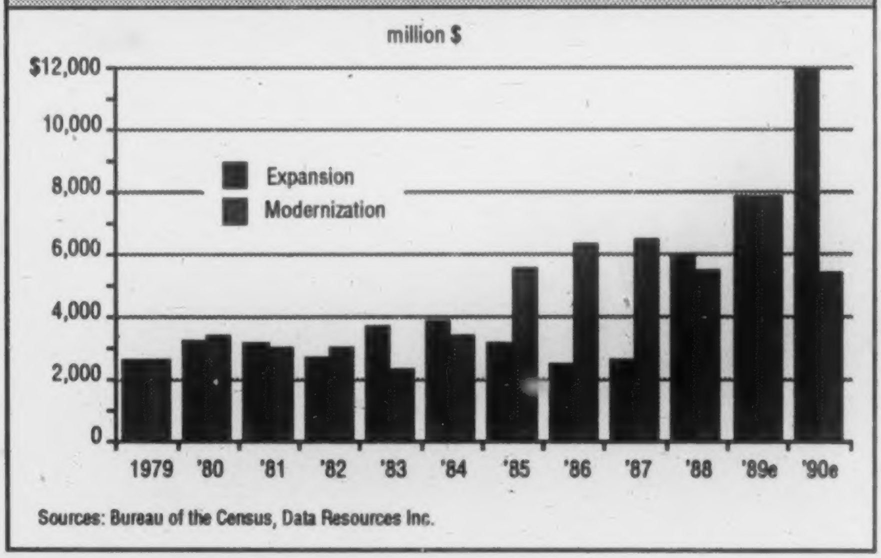
Despite the slowdown, U.S. paper industry capital spending is likely to set a new record in 1990. And paper producers are planning the largest percentage increase in capital spending among major U.S. manufacturing industries. Spending of $17.72 billion in 1990 would represent an increase of 12.9% over 1989—a substantial gain, although not in the same league as the gains of 26.1% in 1988 and 38.1% in 1989.

HISTORICAL TRENDS

U.S. pulp and paper companies devoted an increasing portion of their funds to capital improvements during the 1980s. In absolute terms, spending climbed from $5.24 billion in 1979 to $15.69 billion in 1989, an increase of 200%. Capital spending rose from 86% of cash flow in 1978 and 93% in 1979 to well above 100% of cash flow throughout most of the 1980s. To help pay for this increase, companies boosted their long-term debt significantly—from $10.08 billion in 1978 to $27.07 billion in 1988.

U.S. paper industry capital spending dropped 26% in the 1971 recession, but it rose in each of the following ten

MODERNIZATION VS EXPANSION IN U.S. CAPITAL SPENDING



Sources: Bureau of the Census, Data Resources Inc.

years. During this period, environmental compliance was the major engine driving capital outlays. During the 1972-75 period, between 30% and 38% of total primary industry capital spending went for air, water, and solid waste control, according to the National Council of the Paper Industry for Air & Stream Improvement.

Following the oil-price shocks of the 1970s, a substantial percentage of industry capital was claimed by energy programs to reduce dependence on fossil fuels and to improve efficiency. That trend held steady through 1982 before dropping the following year because of the recession. Since then, cogeneration plants have become a major focus of energy spending. In many cases, these plants are being built, owned, and operated by outside contractors; the mill supplies fuel for the plant and takes the power generated.

Skyrocketing costs. Rapid inflation in construction and capital goods costs was another major factor in the 14%/year rise in industry capital spending during the 1970s. The following comparisons, though inexact, show how the costs of building new greenfield mills in several key grades have escalated. In 1971, Weyerhaeuser Co. built a new 1,600-tpd containerboard mill at Valliant, Okla., for about $100 million, or about $62,500/daily ton. Ten years later, International Paper Co.'s 2,070-tpd Mansfield, La., mill was completed for about $600 million, or about $290,000/daily ton. Mead Corp. is completing work in 1990 on a 1,000-tpd unbleached kraft boxboard and linerboard mill at Mahrt, Ala. The new facility is expected to cost $556 million, or about $556,000/daily ton.

Weyerhaeuser completed a 600-tpd kraft market pulp mill at New Bern, N.C., in 1970 for $50 million, or $83,000/daily ton. Great Northern Nekoosa Corp.'s 1,030-tpd greenfield Leaf River market pulp mill, started up in 1984, cost $560 million, or roughly $544,000/daily ton. Parsons & Whittemore Inc. is building a new 1,400-tpd bleached softwood kraft market pulp plant at its existing mill complex at Claiborne, Ala. Slated for startup in 1991, the $700-million facility will cost about $508,000/daily ton.

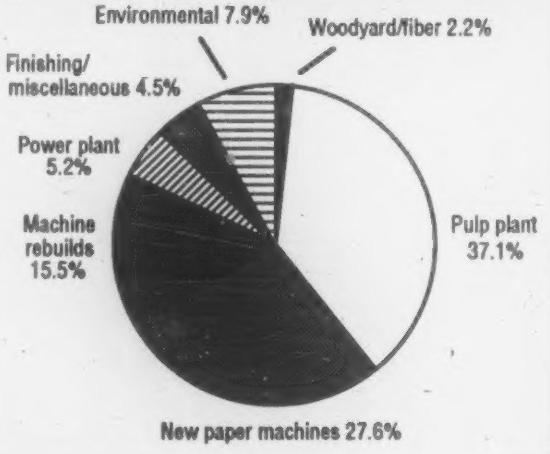
Started up in 1984, Union Camp Corp.'s integrated 600-tpd uncoated free-sheet mill at Eastover, S.C., cost $485 million, or $808,000/daily ton. In contrast, Champion International Corp. built a $100-million, 500-tpd bleached kraft pulp and paper mill at Courtland, Ala., in 1971 for $200,000/daily ton. Union Camp is currently expanding the Eastover mill in a $700-million program (about $631,000/daily ton) to add 290,000 tpy of uncoated free-sheet and 105,000 tpy of bleached kraft market pulp. Willamette Industries Inc. is building a 200,000-tpy uncoated free-sheet mill at Bennetsville, S.C., for an estimated cost of $325 million, or $578,000/daily ton.

SPENDING PLANS; 1990 AND BEYOND

Pulp & Paper Project Report's mid-year survey of spending plans for the 1990-92 period confirmed the expected slowdown in spending for 1990. Capital spending will rise this year in the U.S., but the percentage increase will be lower than was expected last fall.

Environmental improvements have replaced capacity expansion as the driving force behind spending plans. At existing mills, environmental projects now account for 7.9% of total spending in the U.S., up from 3.8% a year earlier. Most of this increased spending will go toward reducing dioxin formation and controlling odor at kraft pulp mills.

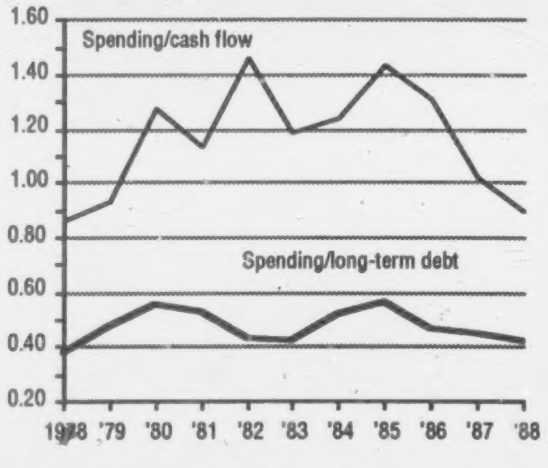
ESTIMATED CAPITAL SPENDING AT EXISTING MILL SITES, BY PROCESS AREA



Total: $13,766,567

Source: *Pulp & Paper Project Report.*

RATIO OF CAPITAL SPENDING VS CASH FLOW AND LONG-TERM DEBT



Sources: American Paper Institute, Federal Trade Commission, Bureau of the Census.

Major capacity additions for coated and uncoated free-sheet are coming online this year and next, and a cycle of above-average growth in newsprint was completed in 1990 with the startup of Alabama River Newsprint Co.'s new mill in Claiborne, Ala. Looking ahead, capacity growth will be strongest in recycled grades, including tissue, newsprint, and containerboard. Deinked pulp installations are booming thanks to legislated demand for recycled-content papers, and the major tissue producers are gearing up for a period of above-average capacity expansion.

In *Project Report*'s mid-1990 review, U.S. companies reported plans to spend $15.3 billion on projects for completion during the 1990-92+ period, an increase of 10.3% over plans reported a year earlier for the 1989-91+ period. The backlog of "proposed" projects—under consideration but not under way—rose to $4.0 billion, up almost 50% from 1989. This total includes several speculative projects that are seeking financing, however, and it is doubtful that many of them will be approved given current market conditions. Mechanical pulp mill proposals in particular appear unlikely to proceed because of weak markets.

Projects for startup in 1990 accounted for $6.9 billion of the reported outlays. Project announcements totaled $5.8 billion for 1991, $2.2 billion for 1992, and $1.2 billion for 1993. This pattern of progressively lower outlays is more evidence for a downturn in spending, since the past few strong years have followed the opposite pattern.

Among U.S. companies with the largest capital programs this year—totaling close to $1 billion or more—are International Paper, Champion International, and Weyerhaeuser. Scott Paper Co. plans to spend about $1.4 billion over the 1990-91 period, and although specific spending amounts are not available, Procter & Gamble Co. has announced plans for a major expansion of its toilet tissue and paper towel business.

Georgia-Pacific Corp. plans to spend $800 to $900 million this year, following its acquisition of Great Northern Nekoosa, but this is down from about $1.03 billion in 1989 for both companies on a combined pro forma basis. G-P is trying to reduce debt incurred in the acquisition as rapidly as possible. Analysts report that G-P management is determined to keep capital spending as low as possible during this period, somewhere in the $400- to $500-million range required to cover annual maintenance costs.

Spending plans for scheduled improvements at existing mills totaled $13.8 billion in the mid-1990 *Project Report* review, up 13.0% from a year earlier. Spending for environmental improvements jumped to $1.1 billion in this year's survey, an increase of 134.5% over last year. Three years of increases have pushed environmental spending to its highest level since the 1970s. Higher spending for environmental programs will be necessary over the next several years to comply with more stringent regulation of both water and air pollution. Current spending plans for environmental improvements make up 7.9% of total outlays, up from 3.8% last year—still well shy of the spending levels of the early 1970s, however.

Pulp mill expansion and modernization projects captured the largest share of spending in this year's survey.

CAPITAL SPENDING PLANS OF MAJOR U.S. PAPER COMPANIES

(million $)

	1990e	1989	Change (%)
Boise Cascade	$723	$723	—
Bowater	235	423	-44.4%
Champion International	1,000	903	10.7
Chesapeake	140	140	—
Consolidated Papers	340	150	126.7
Federal Paper Board	400	400	—
Gaylord Container	202	181	11.6
Georgia-Pacific	800-900*	499	70.3
International Paper	1,100	887	24.0
Kimberly-Clark	850	760	11.8
Mead	550-600	616	-6.7
Pentair	75+	83	-9.6
Pope & Talbot	60	52	15.4
Potlatch	333	143	132.9
Scott Paper	700*	791	-11.5
Stone Container	550	502	9.6
Temple-Inland	260	260	—
Westvaco	500	529	-5.5
Weyerhaeuser	950	974	-2.5
Total	**9,843**	**9,547**	**3.1**

*G-P figure includes Great Northern Nekoosa, acquired in March 1990; Scott spending will total $1.4 billion over 1990-91 period.
n.a. = Not available.
Source: *Pulp & Paper Project Report.*

U.S. PAPER INDUSTRY CAPITAL SPENDING FORECAST FOR 1990

(billion $)

	1990e	1989	% change
Annual spending			
Paper	$17.20	$15.69	9.6%
All manufacturing	190.89	184.54	3.4
Quarterly spending (seasonally adjusted annual rate)			
Paper			
1Q	17.93	14.39	24.6
2Q	17.14	14.87	15.3
3Q	17.20	15.82	8.7
4Q	16.55	17.69	-6.4
All manufacturing			
1Q	192.36	175.22	9.8
2Q	189.53	181.53	4.4
3Q	190.32	187.66	1.4
4Q	191.35	193.76	-1.2

e = Estimate.
Source: Bureau of the Census.

CAPITAL SPENDING BY U.S. PAPER AND ALLIED PRODUCTS ESTABLISHMENTS

(million $)

Year	Total (SIC 26)	Pulp mills	Paper mills	Paperboard mills	Converting plants Paper	Converting plants Containers and boxes	Building paper/board mills
1987	$6,115	$358	$2,762	$795	n.a.	n.a.	n.a.
1986	6,084	875	2,153	1,000	$1,247	$799	$10
1985	6,273	745	2,484	1,043	1,218	764	18
1984	5,302	600	2,412	680	906	681	21
1983	4,987	916	2,239	527	820	470	15
1982	5,098	659	1,856	1,287	786	496	15
1981	5,202	522	2,435	974	746	499	27
1980	5,128	250	1,897	1,539	775	628	40
1979	4,447	240	1,714	1,229	725	491	48
1978	3,736	195	1,424	1,000	604	496	19
1977	3,295	301	1,115	934	507	421	17
1976	3,010	375	1,044	844	394	335	12
1975	2,718	294	832	807	412	347	26
1974	2,214	136	723	637	315	342	63
1973	1,530	119	508	344	304	227	26
1972	1,335	136	372	314	289	206	19
1971	1,197	135	374	228	262	180	18
1970	1,397	122	503	239	289	227	18

Source: Bureau of the Census.

U.S. PAPER AND ALLIED PRODUCTS COMPANIES' CAPITAL SPENDING RELATED TO PROFITABILITY AND CAPACITY UTILIZATION

Year	Capital spending[1] (million $)	Change (%)	Net profit after taxes[2] (million $)	Change (%)	Operating rate[3]
1989	$15,690	38.1%	$7,047	-12.8%	93.0%
1988*	11,360	26.1	8,081	46.4	95.3
1987*	9,010	2.7	5,520	52.1	95.2
1986	8,770	2.1	3,280	13.9	93.7
1985*	8,590	19.1	2,880	-4.1	90.3
1984	7,210	21.8	3,015	29.0	93.6
1983*	5,920	5.7	2,327	60.1	91.4
1982	5,600	-8.3	1,460	-53.0	84.6
1981*	6,110	-6.3	3,110	53.0	91.1
1980*	6,520	24.4	2,800	-45.4	91.9
1979	5,240	37.9	3,723	40.6	94.5
1978*	3,800	9.2	2,598	18.5	92.8
1977*	3,480	16.4	2,367	-1.6	91.4
1976	2,990	2.0	2,270	26.0	89.7
1975	2,930	1.7	1,801	-17.5	79.8
1974*	2,880	44.7	2,287	51.5	93.7
1973*	1,990	36.3	1,441	53.1	96.9
1972	1,460	13.2	941	83.8	96.4
1971*	1,290	-25.9	512	-28.8	91.9

*Revised for change in corporate structure of the industry. Percent changes for sales and profits are computed from data (not shown) consistent with previous year.

Sources: 1. Bureau of the Census. 2. Federal Trade Commission. 3. American Paper Institute (Paper and Paperboard only).

Mills reported plans to spend $5.1 billion on pulping projects during the 1990-92 period, or 37% of overall spending. Pulp mill spending accounted for 35% of total outlays in the 1989 survey and for 24% the year before.

Capacity expansion, environmental upgrading, and cost reduction are the three most important factors in current pulp mill spending plans. Mills are expanding market and captive pulp capacity to support more paper and paperboard production. Environmental improvements center on odor control and reducing chlorine use to limit dioxin formation.

High prices and tight markets have made market pulp capacity expansion the driving force behind pulp mill spending. Several of these projects are at mills that did not previously produce market pulp.

Four major projects scheduled for completion this year will add almost 500,000 tpy of bleached kraft market pulp capacity at a cost of over $800 million. The largest is Weyerhaeuser's startup of a new 358,000-tpy mill at its Columbus, Miss., facility at a cost of $500 million. Bowater Inc. built a complete bleached kraft pulp mill at Calhoun, Tenn., at a cost of $205 million. The other two projects will improve existing facilities at James River Corp., Camas, Wash., and Louisiana-Pacific Corp., Samoa, Calif.

In 1991, Parsons & Whittemore will complete construction of a new $700-million bleached softwood kraft market pulp mill at Claiborne, Ala. The Alabama Pine Co. mill will have capacity for 1,250 metric tpd. Stone Container Corp.'s Port Wentworth, Ga., mill will start up a new 740-tpd bleached hardwood kraft market pulp mill as part of a $335-million modernization, and Union Camp will complete a 105,000-tpy market pulp facility in its $675-million expansion program at Eastover, S.C. Potlatch Corp. plans a new oxygen delignification system and single pulp line to add 45,000 tpy of bleached kraft pulp capacity at Lewiston, Idaho, at a cost of $105 million. A four-year, $408-million modernization at Champion International's Courtland, Ala., mill scheduled for completion in 1993 includes 250,000 tpy of new bleached kraft pulp capacity.

Plans for new pulp mills in Oregon face environmental challenges that have delayed one project and possibly killed another. WTD Industries Inc.'s permit application for a 300,000-tpy, $420-million bleached softwood kraft market pulp mill to be built at Port Westward, Ore., was denied last fall, throwing the project into limbo. Pope & Talbot Inc.'s proposed $350-million expansion at Halsey, Ore., is still in the permitting process and has been pushed back from its original 1991 target date.

Spending for paper machine modifications and improvements is down 0.9% from last year's survey. Spending for scheduled rebuild projects totals $2.1 billion for the 1990-92 period. Rebuilds have contributed the most to new capacity in the containerboard sector, where few new paper machines are being installed. Wide-nip press installations have allowed linerboard and corrugating medium producers to raise capacity for far less than the cost of new machines. Containerboard mills with extensive machine modernization programs include Gaylord Container Corp., Antioch, Calif.; Green Bay Packaging Corp., Green Bay, Wis., and Morrilton, Ark.; MacMillan Bloedel Inc., Pine Hill, Ala.; and Jefferson Smurfit Corp., Jacksonville, Fla.

U.S. mills report plans to spend $715 million on power plant improvements during the 1990-92 period, down 16.5% from last year's plans. Energy projects have slipped to a 5.2% share of spending. Thanks largely to lower energy prices, mills have been able to shift their spending priorities to other areas of the mill. Power plant outlays have declined steadily as a percentage of total mill spending since the early years of the decade.

New paper machines account for 28% of announced spending plans for the 1990-92 period. New paper machine announcements climbed dramatically in the late 1980s, and now 18 new machines at existing mills and another nine machines at new mills are scheduled for startup during the 1990-93 period. The most active grades for new machines are tissue, coated and uncoated free-sheet papers, newsprint, kraft paperboard, and recycled paperboard.

Thirteen new paper machines are scheduled to come online this year, seven at existing mills and six at greenfield facilities. Mead is building a new $556-million coated natural kraft paperboard mill at Phenix City, Ala. Gaylord Container will start up a new 1,000-tpd linerboard machine at Bogalusa, La., the first new linerboard unit to be built since 1985. Union Camp's $375-million modernization and expansion at Savannah, Ga., will replace two older units with a new kraft linerboard machine in 1991, and Jefferson Smurfit Corp. plans a new linerboard machine for its Fernandina Beach, Fla., mill.

In uncoated free-sheet, Willamette Industries is building a greenfield mill at Bennettsville, S.C., for startup in 1990, and Boise Cascade Corp. has undertaken an extensive $525-million modernization and expansion program at International Falls, Minn. Union Camp will complete a $700-million expansion in 1991 that includes a new paper machine at its Eastover, S.C., mill. Also in 1991, G-P will complete a $500-million expansion at Ashdown, Ark., adding 325,000 tpy.

Champion International is installing a new coated free-sheet unit at its Quinnesec, Mich., market pulp mill this year, and Scott Paper's S.D. Warren Div. is building another lightweight coated free-sheet unit at Skowhegan, Maine. In 1991, Consolidated Papers Inc. will complete installation of a new $400-million coated free-sheet machine at the Wisconsin Rapids Div. Boise Cascade announced plans for a $450-million coated groundwood expansion at Rumford, Maine, targeted for completion in late 1993.

This year, Alabama River Newsprint Co., a joint venture of Abitibi-Price Inc. and Parsons & Whittemore, will bring online a newsprint mill at Claiborne, Ala., at a cost of $320 million. North Pacific Paper Corp. has approved a recycled newsprint machine to be installed at Longview, Wash., along with new deinking facilities and pulp improvements. The program is scheduled for completion in 1991.

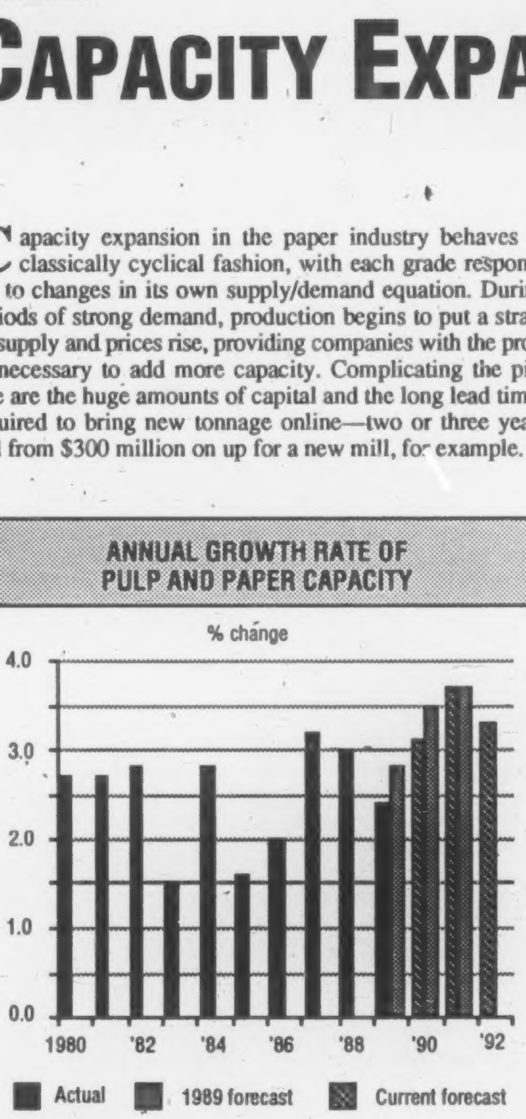
Chesapeake Corp.'s Wisconsin Tissue Mills facility in Menasha, Wis., will start up a new recycled tissue mill this year, and Kimberly-Clark Corp. is building two new tissue mills this year, at Jenks, Okla., and Loudon, Tenn. Fort Howard Corp. plans to install a fourth recycled tissue machine at Rincon, Ga., in 1991.

United States:

CAPACITY EXPANSION

Capacity expansion in the paper industry behaves in classically cyclical fashion, with each grade responding to changes in its own supply/demand equation. During periods of strong demand, production begins to put a strain on supply and prices rise, providing companies with the profits necessary to add more capacity. Complicating the picture are the huge amounts of capital and the long lead times required to bring new tonnage online—two or three years and from $300 million on up for a new mill, for example.

ANNUAL GROWTH RATE OF PULP AND PAPER CAPACITY



Ten-year average for 1980-89: 2.5%.
Average for three-year survey period, 1990-92: 3.4%
Source: American Paper Institute.

Even more volatile cycles occurred during the 1970s and 1980s because of exchange-rate fluctuations, which can completely turn around a country's competitive position. With such forces at work, it is not surprising that expansion cycles often get out of hand, especially in commodity grades such as newsprint, market pulp, and linerboard that are affected by capacity changes and trade conditions around the world.

U.S. pulp and paper companies will continue to expand capacity at an above-average pace over the next few years, according to the American Paper Institute's December 1989 survey of expansion plans. The boom is expected to continue despite weaker demand and lower prices for several grades, which have translated into cuts in capital spending programs. Capital spending should easily set another new record in 1990, although profits appear to have peaked in the third quarter of 1989, putting the potential for continued growth in doubt. As API vice president Richard Storat pointed out in the API capacity report, however, companies' expectations are focused on long-term domestic and worldwide growth and on associated increasing demand for the industry's products. In the present environment, companies have not cut back their expansion plans for 1991, and they plan to continue the boom into 1992, although at a somewhat less heated pace.

Grades where expansion plans have heated up quickly during the past year include recycled paperboard, solid bleached paperboard, and market pulp. Capacity in these three sectors is now expected to climb twice as fast as expected a year ago. Growth will also be well above the ten-year average for unbleached kraft paperboard, tissue, and newsprint, but in line with expectations reported last year. Growth will be strongest in percentage terms for newsprint and coated free-sheet. Other printing and writing grades will post below-average growth rates, however. The groundwood paper grades in particular will grow at a much slower pace than expected a year ago.

Paper and paperboard capacity totaled 80.5 million tons in 1988, about 0.3% more than preliminary figures indicated last year. Capacity in 1989 totaled 82.4 million tons, up 2.4% from 1988. Over the 1990-92 period, producers plan to add another 8.6 million tons to capacity, a three-year increase of 10.5%. That translates into an average annual growth rate of 3.4%, which is about 36% higher than the annual average over the past ten years. The strongest growth will come in 1991, when mills plan to add 3.2 million tons for a one-year gain of 3.7%.

Nine new paper and paperboard machines were brought into production in 1989, and at least 29 additional machines are currently scheduled to come onstream by 1993. New paper and paperboard machine installations in existing mills comprised the largest single component of growth in the API survey, representing 3.8 million tons, or 44.5% of all new capacity. New machine installations in greenfield mills represent 1.2 million tons, or 14.3% of the total. Machine rebuilds and other miscellaneous improvements will account for the remaining 3.6 million tons, which comprise 41.2% of the net capacity gain. The projected growth in paper and paperboard capacity will raise the U.S. industry's potential annual production to 91.1 million tons by 1992.

Consumption of woodpulp, wastepaper, and other fibrous materials as furnish for papermaking will increase at a 3.6% annual rate over the next three years, reaching 91.9 million tons by 1992. Woodpulp will continue to be the industry's primary fiber source, but wastepaper use is projected to grow at nearly twice the rate of virgin fiber use. This exceeds the level projected by producers in last year's survey. Higher levels of wastepaper consumption will be aided by the introduction of major recycling projects throughout the U.S.

Expanded use of wastepaper as a fiber source will occur even as U.S. papermakers continue to add 5.6 million tons of new woodpulp capacity in the next three years, raising the industry's total woodpulp capacity from 64.3 million tons in 1989 to 69.9 million annual tons in 1992. Woodpulp capacity will increase at an annual 2.8% rate, which is slightly less than the 3.4% annual rate projected for paper and paperboard. The differential between woodpulp supply and paper and paperboard production will be made up by the increased use of wastepaper as a fiber source.

Pulp boom to continue. A total of 4.7 million tons of new pulp capacity will be added in the chemical-grade pulps, where sulfate and soda pulps dominate. About 70% of the increase will be in the bleached grades, which are used in printing and writing papers and food packaging. The remaining 30% of the increase will be in unbleached grades used to make containerboard and other packaging grades. The chemical pulps will account for 84% of all new woodpulp capacity additions through 1992, but capacities for sulfite pulp and for dissolving and special alpha pulp are not expected to change.

Mechanical pulp grades have grown at a faster rate than the chemical grades of woodpulp in recent years, owing to the successful introduction of thermomechanical pulp (TMP) and chemi-thermomechanical pulp (CTMP). These pulps reduce the chemical pulp component in newsprint or groundwood papers. Mechanical pulp capacity is expected to increase by 794,000 tons in the next three years. By 1992, TMP and CTMP capacity will total 3.8 million tons, or 51.2% of all mechanical grades.

Significant increases in market pulp capacity are also planned in the next three years, spurred by worldwide demand and high prices for bleached pulp. Market pulp capacity will increase at a 4.5% annual rate, growing from 9.1 million tons in 1989 to 10.4 million tons in 1992. Mills producing market pulp for sale in the open market will hold 15% of all U.S. woodpulp capacity by 1992. Expansion plans have soared in the past year, raising the three-year growth outlook from 1.9% a year in last year's API survey to 4.5% this year. The ten-year growth rate for market pulp has averaged 3.7% a year.

Wastepaper takes off. Consumption of wastepaper in

GROWTH TRENDS IN U.S. PAPER AND PAPERBOARD CAPACITY[1]

(000 short tons)

Year	Total paper and board	Change (%)	Total paper	Change (%)	Total paperboard	Change (%)
1992e	91,077	3.3%	45,600	2.8%	45,476	3.7%
1991e	88,182	3.7	44,342	4.0	43,840	3.5
1990e	85,001	3.1	42,649	3.2	42,352	3.0
3-year change and average annual rate	8,633	3.4	4,274	3.3	4,357	3.4
1989e	82,444	2.4	41,326	2.8	41,119	2.0
1988	80,533	3.0	40,211	2.9	40,322	3.1
1987	78,186	3.2	39,080	2.8	39,106	3.6
1986	75,777	2.0	38,014	1.2	37,763	2.8
1985	74,301	1.6	37,581	1.3	36,720	2.0
1984	73,098	2.8	37,106	4.0	35,992	1.5
1983	71,126	1.5	35,675	2.9	35,451	.1
1982	70,086	2.8	34,665	2.8	35,421	2.8
1981	68,172	2.7	33,706	3.2	34,466	2.2
1980	66,368	2.7	32,659	4.7	33,709	.8
1979	64,615	2.4	31,179	2.4	33,436	1.4
10-year change and average annual rate	17,829	2.5	10,147	2.8	7,683	2.0

e = Estimate.

1. Excludes construction paper and board.

Source: American Paper Institute.

GROWTH TRENDS IN U.S. PAPERBOARD GRADES CAPACITY[1]

(000 short tons)

Year	Unbleached kraft	Change (%)	Solid bleached	Change (%)	Semi-chemical	Change (%)	Recycled	Change (%)
1992e	23,249	3.7%	5,202	3.0%	6,220	3.5%	10,805	4.2%
1991e	22,409	4.3	5,051	4.4	6,010	0.1	10,370	3.4
1990e	21,482	2.9	4,838	2.4	6,003	1.5	10,029	4.3
3-year change and average annual rate	2,382	3.7	479	3.3	303	1.7	1,193	4.0
1989e	20,867	3.0	4,723	-0.2	5,917	2.2	9,612	0.8
1988	20,269	4.4	4,733	0.0	5,788	1.9	9,532	2.9
1987	19,421	4.3	4,735	3.5	5,682	2.2	9,267	2.9
1986	18,622	2.6	4,576	4.7	5,557	2.7	9,008	2.4
1985	18,144	1.7	4,370	4.4	5,411	3.0	8,795	0.8
1984	17,834	1.8	4,185	1.4	5,252	2.6	8,722	-2.7
1983	17,511	0.6	4,129	0.1	5,119	-1.7	8,962	3.1
1982	17,402	4.0	4,123	-0.4	5,207	4.4	8,690	1.1
1981	16,738	4.8	4,141	-0.9	4,988	0.8	8,599	-0.2
1980	15,967	2.7	4,180	-2.1	4,946	1.7	8,617	-1.6
1979	15,546	3.3	4,268	1.7	4,864	2.6	8,757	1.3
10-year change and average annual rate	5,321	3.0	455	1.1	1,053	2.0	855	1.0

e = Estimate.

1. Excludes construction board.

Source: American Paper Institute.

GROWTH TRENDS IN U.S. PAPER GRADES CAPACITY[1]

(000 short tons)

Year	Newsprint	Change (%)	Printing/ writing	Change (%)	Packaging and converting	Change (%)	Tissue	Change (%)
1992e	7,281	2.2%	26,460	3.8%	5,657	1.0%	6,203	1.2%
1991e	7,123	4.6	25,492	4.5	5,600	2.3	6,127	2.6
1990e	6,808	8.4	24,393	2.4	5,475	0.1	5,972	3.6
3-year change and average annual rate	1,001	5.1	2,649	3.6	185	1.1	441	2.5
1989e	6,280	2.7	23,811	3.4	5,472	1.3	5,762	1.7
1988	6,115	1.8	23,027	4.3	5,402	-1.6	5,667	2.9
1987	6,006	3.5	22,077	5.2	5,492	-4.6	5,505	0.6
1986	5,804	0.3	20,980	2.5	5,758	-3.8	5,472	2.4
1985	5,788	-1.1	20,463	2.9	5,985	-1.7	5,345	1.3
1984	5,851	1.3	19,890	6.7	6,088	0.2	5,276	1.7
1983	5,774	2.1	18,633	4.6	6,078	0.0	5,190	1.3
1982	5,654	3.6	17,809	2.9	6,076	2.8	5,125	1.8
1981	5,457	12.8	17,302	3.0	5,913	-2.6	5,035	1.6
1980	4,836	15.2	16,798	4.6	6,072	0.3	4,954	1.7
1979	4,199	2.3	16,057	3.2	6,053	–1.5	4,870	4.9
10-year change and average annual rate	2,081	4.1	7,754	4.0	-581	-1.0	892	2.0

e = Estimate.

1. Excludes construction paper.

Source: American Paper Institute.

the manufacture of paper and paperboard will grow from an estimated 20.9 million tons in 1989 to nearly 25 million tons by 1992. The growth rate for wastepaper consumption will average 6.2% annually during the next three years, nearly twice as fast as the growth of virgin fiber sources. The percentage of wastepaper used by the industry will increase from 25.4% of fiber supply in 1989 to 27.2% in 1992. In early 1990, the industry announced a national goal of 40% paper recovery for recycling by the end of 1995—a 50% increase over the 1988 level. Primary and secondary woodpulp sources will drop from 74.6% of fiber supply in 1989 to 72.8% in 1992.

More than a dozen states have already implemented laws urging manufacturers to use more recycled fiber. This situation has led to a boom in secondary fiber expansion projects and proposals as papermakers scramble to position themselves to comply with the new recycling mandate. Most wastepaper has traditionally been consumed at paperboard mills, but expansions in recycled tissue and newsprint have accelerated. Almost 60 wastepaper processing projects, including several greenfield mills, were either scheduled or under consideration in mid-1990 in the U.S.

Newsprint oversupply. U.S. newsprint capacity growth will lead all other paper and paperboard grades in the next three years. Newsprint capacity will increase from 6.3 million tons in 1989 to 7.3 million tons in 1992, a 5.1% annual growth rate. This growth is paced by the addition of three new paper machines that came onstream in 1989, plus two

GROWTH TRENDS IN U.S. WOODPULP CAPACITY[1]

(000 short tons)

Year	Total pulp	Change (%)	Market pulp	Change (%)
1992e	69,896	2.3%	10,382	6.6%
1991e	68,336	3.5	9,742	4.4
1990e	66,048	2.7	9,335	2.7
3-year change and average annual rate	5,608	2.8	1,291	4.5
1989e	64,288	2.1	9,091	2.1
1988	62,950	2.9	8,908	4.7
1987	61,172	2.4	8,505	5.8
1986	59,750	1.9	8,039	.6
1985	58,641	1.6	7,989	6.1
1984	57,742	2.8	7,530	1.6
1983	56,143	.0	7,414	4.7
1982	56,125	2.2	7,079	1.5
1981	54,891	3.1	6,972	2.5
1980	53,215	3.1	6,801	7.4
1979	51,637	3.7	6,334	10.2
10-year change and average annual rate	12,651	2.4	2,757	4.3

e = Estimate.
1. Excludes pulp for construction paper and board.
Source: American Paper Institute.

GROWTH TRENDS IN U.S. PULP GRADES CAPACITY[1]

(000 short tons)

	Dissolving and special alpha	Change (%)	Sulfite	Change (%)	Sulfate, soda, and screenings	Change (%)	Semi-chemical	Change (%)	Mechanical	Change (%)
1992e	1,495	0.0%	1,622	0.0%	54,386	2.8%	4,967	0.%1	7,426	0.9%
1991e	1,495	0.0	1,622	0.0	52,892	3.9	4,964	0.8	7,363	3.6
1990e	1,495	0.0	1,622	0.2	50,900	2.5	4,925	1.2	7,105	7.1
3-year change and average annual rate		0.0	3	0.1	4,710	3.1	102	0.7	794	3.9
1989e	1,495	3.1	1,619	-0.5	49,676	2.1	4,865	1.6	6,632	3.1
1988	1,450	4.4	1,627	-1.2	48,654	3.1	4,787	1.9	6,432	2.8
1987	1,389	-0.7	1,646	-3.3	47,185	2.7	4,697	1.4	6,256	3.3
1986	1,399	-3.8	1,703	-2.0	45,952	2.5	4,631	-0.4	6,058	1.6
1985	1,454	-2.2	1,738	-0.7	44,835	2.5	4,650	0.5	5,964	-2.6
1984	1,487	-2.5	1,750	-2.1	43,758	2.9	4,625	3.0	6,122	5.3
1983	1,525	-5.0	1,788	0.4	42,526	0.7	4,490	-5.2	5,814	0.6
1982	1,606	0.5	1,780	-4.0	42,225	2.1	4,734	3.0	5,780	5.2
1981	1,598	0.5	1,855	-2.8	41,346	3.3	4,597	-0.1	5,494	8.4
1980	1,590	2.5	1,909	-4.7	40,044	2.8	4,601	1.1	5,070	10.9
1979	1,551	-1.4	2,004	-4.3	38,956	2.6	4,553	-0.4	4,573	-0.2
10-year change and average annual rate	-56	-0.4	-385	-2.3	10,720	2.5	312	0.6	2,059	3.5

e = Estimate.
1. Excludes pulp for construction paper and board.
Source: American Paper Institute.

additional machines planned for 1990 and 1991. Roughly 600,000 tpy of newsprint capacity came online in 1989 from the three new paper machines at Newsprint South Inc., Grenada, Miss.; Ponderay Newsprint Co., Usk, Wash.; and Southeast Paper Mfg. Co, Dublin, Ga. This year, Alabama River Newsprint Co., a joint venture of Abitibi-Price Inc. and Parsons & Whittemore Inc., will bring online a 243,000-tpy newsprint mill at Claiborne, Ala. North Pacific Paper Corp. has approved a new 253,500-tpy recycled newsprint machine to be installed at Longview, Wash., in 1991.

While virgin newsprint is likely to suffer from overcapacity in the next three years, there is a scramble to produce recycled newsprint containing between 25% and 50% secondary fiber content. Southeast Paper's was the only recent installation started up with deinking capacity. North Pacific will install a deinking facility to supply its new newsprint machine scheduled for startup in 1991. Smurfit Newsprint Corp. has approved a new recycled newsprint mill for the Northeast, but timing and location remain uncertain.

Printing/writing slowdown. Capacity for printing and writing papers is expected to increase at a 3.6% annual rate in the next three years, slightly below the 3.9% growth rate projected in 1989. Seven new paper machines, four dedicated to uncoated free-sheet and three to coated free-sheet grades, are now under construction for startup in 1990 and 1991. Between 1990 and 1992, capacity for uncoated free-sheet will climb 3.5% a year, or a total of 1.3 million tons. Coated free-sheet growth will average 8.8% a year, raising capacity 1.1 million tons by 1992. Coated groundwood will increase at only a 1.5% annual rate, and uncoated groundwood will increase at a 1.1% annual rate.

The current weakness in coated paper markets has caused the postponement of two new coated groundwood paper machines planned by Blandin Paper Co. and Bowater Inc. Fraser Inc. has also indefinitely postponed a new lightweight coated paper machine. In contrast to the coated groundwood grades, capacity expansions for coated free-sheet are on schedule, including the installation of the first paper machine at Champion International Corp.'s Quinnesec, Mich., bleached kraft pulp mill. Projected annual growth through 1992 of 9.6% a year compares with a ten-year average of 5.0%.

Lake Superior Paper Industries Inc. has delayed a decision to add a new supercalendered (SC) groundwood paper machine in Minnesota, and Daishowa America Co. has postponed plans to install a new groundwood directory paper machine at its Port Angeles, Wash., mill.

Four new tissue paper machines, including two greenfield mills built by Kimberly-Clark Corp., will add 441,000 annual tons of new capacity by 1992. Industry capacity will increase from 5.8 million tons in 1989 to 6.2 million tons in 1992. These new capacity additions include facilities for the production of both household and industrial tissue grades, and 80% of the new capacity will be based on wastepaper as a fiber source. Fort Howard Corp. is considering new tissue machines for all three of its mills, and Scott Paper Co. and

REGIONAL CAPACITY DISTRIBUTION

(000 short tons)

	1992e	1988	1980	1975
Total paper/board[1]				
New England	6,601	6,185	5,536	5,106
Mid-Atlantic	5,631	5,460	5,801	5,760
East North Central	14,277	12,645	10,440	10,110
West North Central	2,476	1,759	1,290	1,193
South Atlantic	21,862	19,717	16,455	14,396
East South Central	12,696	10,648	8,152	7,380
West South Central	14,298	12,229	9,632	8,487
Mountain/Pacific	13,235	11,889	9,364	8,423
Total U.S.	91,076	80,532	66,670	60,855
Total woodpulp[1]				
New England	3,553	3,403	3,123	2,736
Mid-Atlantic	1,441	1,420	1,315	1,285
East North Central	4,119	3,916	3,188	2,906
West North Central	1,082	739	577	685
South Atlantic	22,111	19,845	16,902	15,220
East South Central	13,848	11,679	9,062	7,675
West South Central	12,434	11,282	9,821	8,971
Mountain/Pacific	11,306	10,666	9,228	8,861
Total U.S.	69,894	62,950	53,216	48,339

Regions are as follows:
New England: Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island.
Mid-Atlantic: New York, Pennsylvania, New Jersey.
East North Central: Wisconsin, Michigan, Illinois, Indiana, Ohio.
West North Central: North Dakota, South Dakota, Minnesota, Nebraska, Iowa, Kansas, Missouri.
South Atlantic: Delaware, Maryland, West Virginia, Virginia, North Carolina, South Carolina, Georgia, Florida.
East South Central: Kentucky, Tennessee, Mississippi, Alabama.
West South Central: Oklahoma, Arkansas, Texas, Louisiana.
Mountain/Pacific: Washington, Oregon, California, Nevada, Idaho, Montana, Wyoming, Utah, Arizona, New Mexico.

e = Estimate.
1. Excludes construction paper and board and pulp to produce these grades.
Source: American Paper Institute.

NEW MILLS AND PAPER MACHINES ANNOUNCED FOR U.S.

Company	Location	Project	Grade	Capacity (tpy)
Started up in 1989				
Atlas Paper Mills	Hialeah, Fla.	New machine	Tissue	14,000
Blandin Paper	Grand Rapids, Minn.	New machine	Coated groundwood	254,000*
Fort Howard	Rincon, Ga.	New machine	Tissue	88,500
Fort Howard	Green Bay, Wis.	New machine	Tissue	n.a.
FSC Paper	Alsip, Ill.	New mill	Tissue	80,000
Hollingsworth & Vose	Hawkinsville, Ga.	New machine	Specialty industrial	n.a.
Kimberly-Clark	Whiting, Wis.	New machine	Cotton fiber paper	30,000
Newsprint South	Grenada, Miss.	New mill	Newsprint	225,000
Ponderay Newsprint	Usk, Wash.	New mill	Newsprint	198,500
Southeast Paper Mfg.	Dublin, Ga.	New machine	Newsprint	210,000
For 1990 startup				
Alabama River Newsprint	Claiborne, Ala.	New mill	Newsprint	243,000
Boise Cascade	International Falls, Minn.	New machine	Uncoated free-sheet	300,000
Champion International	Quinnesec, Mich.	New machine	Coated free-sheet	265,000
Chesapeake	Menasha, Wis.	New machine	Tissue	80,000
Consolidated Papers	Stevens Point, Wis.	New machine	Specialty coated	59,000
Gaylord Container	Bogalusa, La.	New machine	Unbleached kraft liner	355,000
Kimberly-Clark	Jenks, Okla.	New mill	Tissue	68,000
Kimberly-Clark	Loudon, Tenn.	New mill	Tissue	34,000
Longview Fibre	Longview, Wash.	New machine	Kraft paper	107,000
Mead	Mahrt, Ala.	New mill	Coated kraft paperboard	350,000
Scott/Warren	Skowhegan, Maine	New machine	Coated free-sheet	215,000
Willamette Industries	Bennetsville, S.C.	New mill	Uncoated free-sheet	200,000
For 1991 startup				
Consolidated Papers	Wisconsin Rapids, Wis.	New machine	Coated free-sheet	212,000
Fort Howard	Rincon, Ga.	New machine	Tissue	88,500
Mi Ho Paper	St. Joseph, Mo.	New mill	Recycled fine paper	n.a.
Nekoosa Papers	Ashdown, Ark.	New machine	Uncoated free-sheet	325,000
Parsons & Whittemore	Claiborne, Ala.	New mill	Bleached kraft pulp	468,500
Union Camp	Savannah, Ga.	New machine	Unbleached kraft liner	460,000*
Union Camp	Eastover, S.C.	New machine	Uncoated free-sheet	240,000
Weyerhaeuser/North Pacific	Longview, Wash.	New machine	Newsprint	253,500
For 1992 startup				
Daishowa/Trans-Rim	Stockton, Calif.	New mill	Recycled containerboard	350,000
Federal Paper Board	Augusta, Ga.	New machine	Bleached bristols	233,500
International Paper	Selma, Ala.	New machine	Uncoated free-sheet	n.a.
Potlatch	Lewiston, Idaho	New machine	Tissue	n.a.
Jefferson Smurfit	Fernandina Beach, Fla.	New machine	Linerboard	n.a.
Westvaco	Covington, Va.	New machine	Bleached paperboard	350,000
For 1993 startup				
Boise Cascade	Rumford, Maine	New machine	Coated groundwood	318,000
Inland Container	Maysville, Ky.	New mill	Recycled containerboard	212,500
Kenaf Paper	Ramondville, Texas	New mill	Newsprint	33,000
Proposed projects (no startup date announced)				
Dunkirk Paperboard	Dunkirk, N.Y.	New mill	Recycled containerboard	250,000
Fort Howard	Muskogee, Okla.	New machine	Tissue	n.a.
Fort Howard	Green Bay, Wis.	New machine	Tissue	n.a.
Golden State Paper	Pomona, Calif.	New machine	Newsprint	230,000
Gulf States Paper	Demopolis, Ala.	New machine	Bleached paperboard	n.a.
Mead	Upper Peninsula, Mich.	New mill	Coated free-sheet	n.a.
Northampton Paperboard	Northampton, Pa.	New mill	Recycled paperboard	212,000
Procter & Gamble	Oxnard, Calif.	New machine	Tissue	n.a.
Scott Paper	Indiana or Kentucky	New mill	Tissue	n.a.
Jefferson Smurfit	Northeast U.S.	New mill	Newsprint	280,000

* Replaces some existing capacity.
n.a. = Not available.
Source: *Pulp & Paper Project Report.*

Procter & Gamble Co. have both announced expansion plans for the early-to-mid 1990s.

The long-term decline in kraft and specialty packaging and industrial papers bottomed out in 1989, and capacity is projected to increase at a 1.1% annual rate in the next three years. These additions will raise capacity from about 5.4 million tons in 1989 to 5.6 million tons in 1992. Longview Fibre Co. and Consolidated Papers Inc. are installing new paper machines that will make a variety of lightweight specialty packaging grades. API recently reclassified 275,000 tons of unbleached kraft paper capacity and 75,000 tons of bleached kraft paper capacity from the commodity kraft grades to specialty grades.

Four new linerboard machines. Producers of unbleached kraft paperboard will add 2.4 million tons of new capacity in the next three years, which represents a 3.7% annual growth rate. This rate of capacity growth is slightly lower than last year's estimate because producers have lowered their kraft linerboard estimate for 1991 by about 200,000 tons. Nevertheless, kraft linerboard, the major product in this category, will add 2.1 million tons during the next three years, raising capacity to about 21.3 million tons by 1992.

Four new kraft paperboard machines will supply 48% of the total increase in capacity. Machine rebuilds, installations of high-pressure presses, and other machine improvements will provide the remaining 52% of the total increase. Gaylord Container Corp., Union Camp Corp., and probably Weyerhaeuser Co. (the latter must still be approved) will install new kraft linerboard machines in the next three years, but some of this new capacity will replace existing capacity that will be permanently shut down. Mead Corp. will start up a new kraft paperboard machine by the end of 1990 that will be capable of producing coated folding carton grades as well as lightweight linerboard.

Recycled linerboard capacity is expected to more than double from 455,000 annual tons in 1989 to 1.2 million tons in 1992. New greenfield recycled linerboard projects are planned by Daishowa America, in a joint venture with Trans-Rim Enterprises Ltd., and by Inland Container Corp., which plans to build a new recycled containerboard mill in Kentucky for startup in 1993. Additional recycled containerboard projects now under study are expected to augment this trend. Growth will average 4.0% a year through 1992, compared with just 0.9% annually between 1980 and 1989.

Semichemical corrugating medium capacity growth will be lower than kraft linerboard growth rates because of the increased use of recycled corrugating medium. Semichemical capacity will increase only 303,000 tons over the next three years, with growth averaging 1.7% a year. In contrast, capacity for recycled corrugating medium will increase by 230,000 tons, for an 11.3% annual growth rate.

SBS expands to ease shortages. The market shortage of solid bleached paperboard will be alleviated in the next three years as producers add 479,000 tons to the capacity base. This 3.3% annual growth rate will raise industry capacity from 4.7 million tons in 1989 to 5.2 million tons by 1992. Westvaco Corp. will install a fourth paper machine at its Covington, Va., mill that will have 220,000 tons of capacity at startup in 1992, but this will ultimately expand to 350,000 tpy. This will be the first major new machine installation for the solid bleached sulfate grades since Westva-

INDEFINITELY IDLED PULP AND PAPER MILLS IN U.S.

Company	Mill	Grade
Boise Cascade	Elizabeth, La.	Kraft paper
Boise Cascade	Brownville, N.Y.	Recycled paperboard
Contoocook Paper	West Henniker, N.H.	Latex-saturated papers
Crown Paper Board	Philadelphia, Pa.	Recycled paperboard
Deerfield Specialty Papers	Monroe Bridge, Mass.	Specialty papers
Doeskin	Clayville, N.Y.	Tissue
Erving Paper Mills	Lockland, Ohio	Specialty papers
Evers Paper	Utica, N.Y.	Recycled paperboard
Falls Tissue	Mechanic Falls, Maine	Tissue
Hinsdale Products	Hinsdale, N.H.	Tissue
International Paper	Bastrop, La.	Semichemical medium
International Paper	Springhill, La.	Kraft paper/board
International Paper	Reigelsville, Pa.	Recycled paperboard
Keyes Fibre	Shawmut, Maine	Groundwood pulp
Nicolet	Ambler, Pa.	Gasket board
Nicolet	Norristown, Pa.	Asbestos paper
Nickal Paper	Kalamazoo, Mich.	Recycled linerboard
Packaging Corp. of America	Middletown, Ohio	Molded pulp
Pennsylvania General	Buck Run, Pa.	Tissue
Ponderosa St. Lawrence	Ogdensburg, N.Y.	Deinked market pulp
Reading-Whitehall Paper Board	Whitehall, Md.	Boxboard
Riegel Div., James River	Riegelsville, N.J.	Specialty papers
Simkins Industries	Miami, Fla.	Recycled paperboard
Skybel Tissue Mills	Greenwich, N.Y.	Tissue
Sonoco Products	Richmond, Calif.	Recycled paperboard
Specialty Paperboard	Beaver Falls, N.Y.	Groundwood pulp
Texcrom Paper	Chambersburg, Pa.	Kraft toweling
TLR Corp.	Bellows Falls, Vt.	Groundwood specialties
Toronto Paperboard	Toronto, Ohio	Recycled paperboard
Vincennes Paper Mills	Vincennes, Ind.	Recycled paperboard
Warrensburg Board & Paper	Warrensburg, N.Y.	Corrugating medium
Whippany Paper Board	Whippany, N.J.	Recycled paperboard

Source: *1990 Lockwood-Post's Directory.*

co's last new machine in 1986. Federal Paper Board Co. had planned to install a new bleached paperboard machine at its Augusta, Ga., mill in 1992, but the company indicated in mid-1990 that it may switch the machine to uncoated free-sheet instead. International Paper Co., Potlatch Corp., Temple Inland Forest Products Corp., Georgia-Pacific Corp., and Gulf States Paper Corp. have undertaken machine rebuilds and debottlenecking projects that will also add incremental capacity in the next few years.

Producers of the recycled boxboard packaging grades have enjoyed a revival in recent years and plan to increase capacity by about 1.5% yearly in the next three years.

PAPER AND PAPERBOARD CAPACITY REDUCTIONS

	Number of paper machines shut down[1]				Number of paper mills shut down[1]			
	1971-75	1976-80	1981-85	1986-92e	1971-75	1976-80	1981-85	1986-92e
Paper								
Newsprint	—	3	5	—	—	1	—	—
Printing/writing	51	32	38	24	8	5	4	2
Packaging/industrial converting	35	32	31	13	8	7	7	3
Tissue	6	25	30	10	4	8	13	3
Paperboard								
Unbleached kraft	2	2	5	4	—	1	—	—
Solid bleached	1	2	—	2	—	1	—	—
Semichemical	3	4	7	3	1	1	2	—
Recycled	29	35	18	7	14	12	12	3
Total paper and board[2]	**127**	**135**	**134**	**63**	**35**	**36**	**38**	**11**
Average rate/year	25	27	27	11	7	7	8	2

e = Estimate.

1. Includes machines converted to other grades.

2. Excludes construction grades.

Source: American Paper Institute.

PAPER AND PAPERBOARD CAPACITY REDUCTIONS

(000 short tpy)

	1971-75	1976-80	1981-85	1986-92e
Paper				
Newsprint	—	231	360	—
Printing/writing	803	550	771	437
Packaging/industrial converting	290	395	821	545
Tissue	52	246	308	51
Paperboard				
Unbleached kraft	128	400	742	787
Solid bleached	33	162	—	142
Semichemical	123	178	553	360
Recycled	872	1,295	644	118
Total paper and board*	**2,301**	**3,457**	**4,199**	**2,440**
Average rate/year	460	691	840	407

e = Estimate.

* Excludes construction grades.

Source: American Paper Institute.

United States:

MERGERS AND ACQUISITIONS

Mergers and acquisitions have proved as big a hit in the paper industry as they have in the rest of the business world during the 1980s. There have been 31 major deals in the paper industry since 1983, according to Morgan Stanley & Co., and the value of the transactions reached $28 billion. They involved 31 million tons of primary capacity, or 33% of U.S. paper capacity.

According to First Boston analysts, the average value of transactions in the mid-1980s was about $600 million, with 20 deals in the $100-million range. Through 1987, six multibillion-dollar deals involved paper companies, beginning with Champion International Corp.'s buyout of St. Regis Corp. in 1984 for $1.84 billion. Then in mid-1988, a $3.96-billion leveraged buyout (LBO) of Fort Howard Corp. set a new high for industry acquisitions. Georgia-Pacific Corp. closed the decade with a bang by offering $3.47 billion for Great Northern Nekoosa Corp.

Between 1983 and 1987, nine of the top industry producers (those with capacity for 1,000 tpd or more) disappeared—all of them swallowed up by other companies. This group included Container Corp. of America, Continental Forest Industries, Crown Zellerbach Corp., Hammermill Paper Co., Jacksonville Kraft Co., Owens-Illinois Inc.'s Forest Products Group, Publishers Paper Co., St. Regis Paper & Bag Co., and Southwest Forest Industries Inc. The industry is trending toward higher concentration. The top 15 producers held 54% of the industry's paper and board capacity in 1983, and 61% in 1989.

Acquisitions provided a way for firms to gain market share without adding capacity to markets that in some cases were already loose. And they could do so at a fraction of the cost of building new facilities. For example, First Boston estimated that Georgia-Pacific paid just 41% of replacement cost for Brunswick Pulp & Paper Co. in late 1988.

In addition to the buy-vs-build factor, a number of other forces have driven the frantic buying and selling of the 1980s. Readily available funds and a lax antitrust environment encouraged acquisitions. Whole new financial industries sprang up around the LBO and junk bonds, and more traditional bank loans and equity financing opportunities also grew tremendously. Sheer size, which used to protect companies from unwanted suitors, was no longer a good defense.

However, the junk-bond market fell into disarray in 1989, putting speculators at a disadvantage. With funding getting decidedly tight, many deals fell through, and the nature of acquisitions changed. Rather than outside investors buying paper firms and breaking them up into pieces to sell, paper companies themselves entered the fray, searching for synergy and consolidation.

HOSTILE TAKEOVER ATTEMPTS

Corporate raiders are less of a threat now than they were a few years ago. Most companies have taken steps to prevent hostile takeovers, such as selling off assets that might attract raiders, restructuring debt, and staggering directorships. USG Industries Inc. successfully fought off a hostile takeover attempt by Desert Partners in 1988 by pushing through its own recapitalization plan, for example.

In another case, a $21-billion bid for B.A.T Industries plc was launched late in 1989 by Sir James Goldsmith, one of the biggest corporate raiders and no stranger to the paper industry. The bid failed when the company decided to divest its paper, retail, and financial businesses. As a result, Wiggins Teape Group Ltd. and Appleton Papers Inc. were combined in a new, publicly held holding company run by management from the two firms.

Even if Goldsmith had bought B.A.T and divested certain groups—which he indicated was his intention—he would not have gained as much as he would have prior to U.S. tax law changes. The 1986 and 1987 tax reforms made it costly for raiders to sell off assets quickly. In addition, raiders have suffered adverse publicity from insider-trading scandals, and many states have passed laws limiting hostile takeovers. Georgia-Pacific late in 1989 was challenging such a law in Maine as it attempted to take over Great Northern Nekoosa.

In the spring of 1990, the Supreme Court backed states' rights to undo a merger if it is anticompetitive. And Pennsylvania adopted what may be the toughest antitakeover statute in the U.S. It includes a provision to return to the target firm any profits of short-term shareholders who sell shares within 18 months of a failed buyout attempt or proxy battle. It also suspends the voting rights of holders of 20% or more of a company's stock until other shareholders reinstate them. Firms were given the option to exclude themselves within 90 days from protection under the statute. The law has since come under constitutional challenge.

The odds have not shifted completely over to the incumbents, however. Corporate takeover defenses have been geared toward stopping hostile bids opposed by the target company's directors. But the *Wall Street Journal* pointed out that proxy challenges can get around those defenses by using shareholders' votes to replace the board of directors. And staggering the directors' terms does not always work. The *Journal* found that even a third of the directors, if supported by a majority of shareholders, can gain control.

In the early and mid-1980s, raiders made a lot of money toppling U.S. paper companies, whether through successful buyouts or sale of their shares to a higher bidder. Hostile takeover attempts have come almost exclusively from raiders outside the pulp and paper industry. Although aggressive companies like James River Corp. and Stone Container Corp. have been quick to buy the assets of acquired companies, they have not initiated hostile bids themselves. This trend may have changed with Georgia-Pacific's unsolicited bid for Great Northern Nekoosa.

Earlier consolidations within the paper industry occurred after a company had already taken action to divest assets. In 1984, Jefferson Smurfit Corp. purchased a stake in Southwest Forest Industries after a management-led LBO of SFI failed, but merger talks broke down quickly, and Smurfit later agreed not to purchase SFI stock for ten years. In early 1986, SFI had to fend off another takeover attempt, this time from a group of Oklahoma oil and gas investors. SFI was finally purchased in 1987 in a friendly merger with Stone Container worth $760 million.

Goldsmith heads list of raiders. The financier who pursued B.A.T Industries in late 1989, has been the most aggressive suitor of U.S. paper companies, making unsolicited offers for Diamond International Corp., Continental Group Inc., St. Regis, and Crown Zellerbach earlier in the decade. All four companies lost their independence—two to Goldsmith and two to "white knight" purchasers.

Goldsmith's strategy was to seek out undervalued companies with assets that could be sold off easily as independent units. He completed the acquisition of Diamond International in 1982, after buying an initial 5.6% stake in late 1979 and accumulating stock gradually. Total purchase price over the three-year period was about $660 million. Goldsmith then began selling off Diamond's assets one division at a time, grossing roughly $850 million from the sales by 1983. Diamond's paperboard, converting, and printing businesses were sold to Jefferson Smurfit for $80 million in 1982. In 1983, James River bought the company's papermaking assets for $170 million.

Goldsmith's next industry target was Continental Group, an insurance, energy, and packaging company and the largest U.S. producer of bleached paperboard. After purchasing a 1% stake in Continental for about $15 million, Goldsmith offered $50/share for the remainder of the company—or about $2.42 billion. Continental's management rejected the offer and soon afterward agreed to a merger with a company owned 80% by Peter Kiewit Sons and 20% by financier David Murdock's Murdock Investment Corp. That deal was worth $58.50/share, or about $2.79 billion. To finance the acquisition, Kiewit-Murdock sold Continental's bleached paperboard mill at Augusta, Ga., and related assets to Federal Paper Board Co. in early 1985 for $305 million.

In August 1990 Peter Kiewit's Continental Holdings Inc. agreed to sell the Continental Bondware business to Federal Paper Board for an undisclosed amount. Bondware is a major producer of paper cups and disposable food service products with annual sales of $180 million. The previous year, Federal had entered the paper cup market by buying Imperial Cup Corp. for $114 million. The Imperial purchase also boosted integration of Federal's bleached paperboard mills.

Fight for St. Regis. St. Regis suffered at the hands of raiders, including Goldsmith, for most of 1984. Following the same pattern as the Diamond takeover, an investor group led by Goldsmith bought an 8.6% stake in St. Regis that February. The group intended to gradually increase its stake and eventually take over the company, but St. Regis bought back its shares from the group in March, paying a substantial premium over its then-current stock price—a defensive payoff known as "greenmail."

In May, St. Regis sold its Monticello, Miss., linerboard mill and related assets to Georgia-Pacific for $342.5 million. Although a takeover defense was probably not its primary reason—St. Regis had been unhappy with its containerboard operations—the sale did serve to make the company less attractive to unwanted suitors. G-P also became a friendly shareholder through the deal, agreeing to buy an 8.5% stake in St. Regis as part of the transaction.

Proceeds from the sale also improved St. Regis's ability to make acquisitions of its own, and in June, the company agreed to buy insurer Colonial Penn Group Inc. for $590 million. Like G-P, Colonial Penn became a friendly St. Regis shareholder in the preliminary transaction; its stake amounted to 3.5%.

Less than a month later, however, St. Regis was targeted for takeover by Australian publisher Rupert Murdoch, who purchased a 5.6% stake in the company in July. Murdoch made a $52/share offer for the rest of St. Regis later that month, threatening an unfriendly and less generous tender offer if he was denied. Murdoch also demanded that the Colonial Penn deal be called off. St. Regis's board rejected the Australian's offer and blocked a takeover attempt by agreeing in early August to a friendly merger with Champion International in a transaction for stock and cash valued at $2.538 billion. The merger was completed late in 1984.

Champion began almost immediately to sell off pieces

MAJOR ACQUISITIONS INVOLVING U.S. PULP AND PAPER MILL ASSETS

Acquiring company	Assets purchased	Estimated value (million $)	Year effective
Georgia-Pacific Corp.	Great Northern Nekoosa Corp.	$3,740	1990
Willamette Industries Inc.	Penntech Papers Inc.	n.a.	1990
Jefferson Smurfit Group	Golden State Newsprint Co. Inc., Pacific Recycling Co.	95	1990
Jefferson Smurfit Corp.	Keystone Container Corp.	n.a.	1990
Federal Paper Board Co.	Continental Bondware	n.a.	1990
Inland Container Corp.	Crockett Container Corp., Pakway Container Corp.	n.a.	1990
Holzstoff Holding AG	James River's nonwovens group	175	1990
Amcor Ltd.	Completed purchase of Sunclipse Inc.	105	1990
Amcor Ltd.	48% stake in Sunclipse Inc.	90	1989
SIBV/MS Holdings Inc.	Jefferson Smurfit Corp./Container Corp. of America	1,584	1989
Federal Paper Board Co.	Imperial Cup Corp.	114	1989
Sweetheart Holdings Inc.	Fort Howard Corp.'s U.S. and Canadian cup operations	532	1989
Investor group	Howard Paper Mills Inc.	n.a.	1989
Berkshire Hathaway Inc.	8% stake in Champion International Corp.	300	1989
Jujo Paper Co.	Doubled stake in North Pacific Paper Co. to 20%	n.a.	1989
Arcadia Partners L.P.	Ivex Corp.'s three specialty papers mills	n.a.	1989
Warrior River Paper Co.	Howard Paper Mills Inc.'s two printing/writing paper mills	n.a.	1989
Newark Group	Gold Bond Building Products' recycled board mill	n.a.	1989
Kapaco Group	Watervliet Paper Co.'s Watervliet, Mich., specialty papers mill	n.a.	1989
Investor group	APL Corp.'s tissue business	50	1989
Giant Group Ltd.	Garden State Paper Co.'s Pomona, Calif., newsprint mill	56	1989
Preco Corp.	E.B. Eddy's Brewer, Maine, fine paper mill	n.a.	1988
Fairfield Paper Co.	Gaylord Container Corp.'s Baltimore, Ohio, containerboard mill	17	1988
FH Acquisition	Management's leveraged buyout of Fort Howard Paper Co.	3,962	1988
James River Corp.	23% of Diamond Occidental's common stock	25	1988
Settsu Corp.	9.6% stake in USG Corp.	35.5	1988
Caraustar Industries Inc.	USG Corp.'s Camden, N.J., gypsum linerboard mill	n.a.	1988
Valley Converting Co.	Toronto Paperboard Corp.'s recycled board mill	n.a.	1988
Newark Group	Federal Paper Board Co.'s Los Angeles, Calif., recycled board mill	n.a.	1988
Georgia-Pacific Corp.	Brunswick Pulp & Paper Co.	665	1988
Daishowa America Co. Ltd.	Port Angeles, Wash., groundwood paper mill from James River	75	1988
Gaylord Container Corp.	Fibreboard Corp. containerboard assets from Louisiana-Pacific Corp.	156	1988
Kapaco Group	Pentair Inc.'s Detroit, Mich., specialty papers mill	n.a.	1988
Rock-Tenn Co.	Mead Corp.'s recycled paperboard businesses	65	1988
E.B. Eddy Forest Products Ltd.	Port Huron Paper Corp. from Pentair	n.a.	1987
P.H. Glatfelter Co.	Ecusta Corp.	219	1987
Great Northern Nekoosa Corp.	Forest Products Group of Owens-Illinois Inc.	1,170	1987
James River Corp.	Dunn Paper Co. from Dennison Manufacturing	n.a.	1987
Mead Corp.	Georgia Kraft Co. mill in Phenix City, Ala.; part of reorganization and termination of joint venture with Temple-Inland	n.a.	1987
Pope & Talbot Inc.	Ransom, Pa., tissue mill from Potlatch	27	1987
Pratt Holdings Pty Ltd.	Georgia Kraft Co. linerboard mill and related assets in Macon, Ga.	272	1987
Simkins Industries Inc.	Deerfield Specialty Papers from Reed Holdings Inc.	n.a.	1987
Simpson Paper Co.	Pasadena, Texas, free-sheet paper mill of Champion International Corp.	90	1987
Simpson Paper Co.	Plainwell Paper Co. from Chesapeake Corp.	n.a.	1987
Smorgon Consolidated Industries Pty Ltd.	FSC Paper Corp. from Media General and Interstate Holdings	n.a.	1987
Stone Container Corp.	Southwest Forest Industries	760	1987
Stora Kopparberg Group	40% of Mohawk Paper Mills	24	1987
Temple-Inland Inc.	Owens-Illinois' Orange, Texas, linerboard mill	228	1986
Settsu Corp.	21% of Caraustar Industries Inc.	n.a.	1986
Boise Cascade Corp.	Jackson, Ala., mill of Allied Paper Inc.	150	1986
China National Packaging Corp.	Morris Paper Board mill in Paterson, N.J.	n.a.	1986
GC Acquisition Corp.	Gaylord Container, spun off during James River's acquisition of Crown Zellerbach	260	1986

Continued

MAJOR ACQUISITIONS INVOLVING U.S. PULP AND PAPER MILL ASSETS (continued)

Acquiring company	Assets purchased	Estimated value (million $)	Year effective
Hanson Trust plc	Allied Paper Inc. from SCM Corp.	n.a.	1986
International Paper Co.	Hammermill Paper Co.	$1,441	1986
JFC-MS Holdings Inc.	Container Corp. of America from Mobil Corp.	1,139	1986
James River Corp.	Crown Zellerbach Corp. pulp and paper operations	1,428	1986
James River Corp.	Premoid Group from Preco Corp.	n.a.	1986
Rand-Whitney Packaging Corp.	Montville, Conn., boxboard mill from Robertson Paper Box	n.a.	1986
Seminole Kraft Corp.	Jacksonville Kraft Paper Co.	112	1986
Jefferson Smurfit Corp.	80% of Publishers Paper Co. from Times Mirror Inc.; included two newsprint mills	132	1986
Stone Container Corp.	Most of the packaging operations of Champion International	426	1986
Temple-Inland Inc.	Linerboard mill at Orange, Texas, from Owens-Illinois	228	1986
Texcrom Paper Corp.	Chambersburg, Pa., tissue mill from United Paper Mills	n.a.	1986
Mid-America Packaging Inc.	Weyerhaeuser Co.'s Pine Bluff, Ark., containerboard mill	28	1985
Federal Paper Board Co.	Continental Group's Augusta, Ga., bleached board mill	305	1985
Carlyle Investments	Hennepin Paper Co. from Champion International, and Pejepscot Paper Co. from Hearst Corp.	n.a.	1985
Chesapeake Corp.	Wisconsin Tissue Mills and Plainwell Paper from Philip Morris Inc.	210	1985
Ecusta Corp.	Purchased in leveraged buyout from Olin Corp.	130	1985
Hammermill Paper Co.	Nicolet Paper Co. from Philip Morris Inc.	n.a.	1985
International Paper Co.	Durham Mills Inc.'s recycled paperboard mill at Riegelsville, Pa.	n.a.	1985
Lyons Falls Pulp & Paper Inc.	Lyons Falls, N.Y., mill of Georgia-Pacific	n.a.	1985
Petratex Paper Co. Inc.	Specialty kraft paper mill of Bemis Co. at Peoria, Ill.	n.a.	1985
Simpson Paper Co.	Tacoma, Wash., kraft paper mill of Champion International	27	1985
Trident Associates	Two recycled paperboard mills and six folding carton plants from Champion International	n.a.	1985
Appleton Papers Inc.	Glatfelter's West Carrollton, Ohio, mill	83	1984
Boise Cascade Corp.	Sonat's 50% interest in Boise Southern	195	1984
Bowater Inc.	Bowater Corp.'s North American assets	123	1984
Caraustar Industries Inc.	Three Container Corp. of America recycled paperboard mills	n.a.	1984
Champion International Corp.	St. Regis Corp.	2,538	1984
Georgia-Pacific Corp.	Monticello, Miss., linerboard mill and related assets from St. Regis	375	1984
Peter Kiewit Sons	Continental Group Inc.	2,785	1984
Stora Kopparberg Group	Newton Falls Paper Mill	n.a.	1984
Temple-Inland Inc.	Temple-Eastex and Inland Container spun off by Time Inc.	n.a.	1984
Boise Cascade Corp.	Saxon's Missisquoi specialty paperboard mill	n.a.	1983
Haindl Paper Co.	Crown Zellerbach's Port Townsend, Wash., unbleached kraft paper mill	n.a.	1983
Jacksonville Paper Co.	St. Regis kraft paper mill	n.a.	1983
James River Corp.	American Can's Marathon, Ont., pulp mill	n.a.	1983
James River Corp.	Diamond International's pulp and papermaking assets	171	1983
Mosinee Paper Corp.	Sorg Paper Co.	18	1983
Pope & Talbot Inc.	American Can's 50% interest in Halsey, Ore., pulp mill	14	1983
Republic Gypsum Co.	Two PCA recycled boxboard mills	n.a.	1983
Stone Container Corp.	Major portion of Continental Forest's Brown System	510	1983
Technographics Inc.	Litton Industries, including Fitchburg Paper	70	1983
James River Corp.	Most of the assets of American Can Co.	446	1982
Jefferson Smurfit Ltd.	Diamond International Corp.'s paperboard, converting, and printing businesses	80	1982
Sir James Goldsmith	Acquired Diamond International Corp.	455	1982
Jefferson Smurfit Group Ltd.	Alton Box Board Co.	n.a.	1981
James River Corp.	Brown Co.	172	1980
Johns-Manville Corp.	Olinkraft Inc.	n.a.	1979

n.a. = Not available.

of St. Regis in order to pay for the purchase and to better integrate the two companies' operations. It first sold the Tacoma, Wash., kraft pulp and paper mill to Simpson Paper Co. The largest transaction, not completed until early 1986, sent most of the company's packaging operations to Stone Container in a deal worth $457 million. Other assets sold off included Hennepin Paper Co., two recycled paperboard mills and related folding carton plants in the Midwest, and the envelope division. In January 1988, Champion transferred the Canadian operations of St. Regis—including a market pulp mill at Hinton, Alta.—to subsidiary Weldwood of Canada Ltd. in a deal worth $274 million.

Not surprisingly, companies scrambled in 1984 to develop defensive measures that discourage unwanted takeover attempts. Some of these defenses make a takeover more difficult by concentrating shares in the hands of friendly holders, by staggering directors' terms, and by negotiating standstill agreements. Others focus on making a company too expensive (e.g., the preemptive sale of assets that would be sold off by a raider to finance a takeover). A similar defense involves making a large acquisition to boost the targeted company's purchase price, as St. Regis tried to do with Colonial Penn.

One novel approach developed in 1984 is the "poison pill," which gives special purchase rights to shareholders in the event of a hostile takeover attempt. These rights generally allow the holder to purchase shares at a steep discount once a certain threshold level of ownership—usually 20% to 30%—is surpassed by a hostile buyer. Crown Zellerbach and Owens-Illinois were the first in the paper industry to adopt poison pills, followed by Boise Cascade Corp., Bowater, Great Northern Nekoosa, International Paper Co., Southwest Forest Industries, and Union Camp Corp.

Crown Zellerbach taken over. A poison pill and major restructuring were not enough to save Crown Zellerbach from a determined takeover attempt in 1985 by Goldsmith. The British financier, operating through three affiliated companies, began his attack by purchasing an 8.6% stake in CZ in March 1985 for $78.3 million. In April, he made a $42.50/share tender offer for the company, worth $807.5 million. The company rejected that bid as too low, saying it would consider a $60/share offer from Goldsmith or any other source. CZ also announced a major restructuring to separate the company's timberlands and packaging operations from its other businesses.

That same month, a white-knight agreement with Mead fell through, but Goldsmith withdrew his tender offer because of CZ's restructuring plan. As CZ's largest shareholder, Goldsmith was elected to the board of directors in May, and he spent the early summer accumulating more shares and fighting management's restructuring plan. Goldsmith's stake jumped from 19.6% at the beginning of May to 26% by early July, thus activating CZ's poison pill. Goldsmith boosted his stake to 45% by mid-month and finally won control at month's end. The poison pill proved an empty threat because a merger never took place and because a 50% ownership threshold was never reached.

Crown Zellerbach's assets were split up over the next year into four parts. Goldsmith retained the company's timberlands and wood-products businesses. James River purchased most of CZ's papermaking operations in a stock swap valued at about $1.428 billion. With its purchase, James River became one of the five largest paper companies in the U.S. CZ's container division was spun off as Gaylord Container Corp. and purchased by an investor group for $260 million. Finally, CZ's paper distribution business was sold by James River to Mead for $260 million cash, making Mead the largest integrated distributor of paper in the U.S.

Later in 1985, yet another San Francisco, Calif.-based company was targeted. The raiders were the Belzberg brothers of Vancouver, B.C., who offered $45/share—or about $693 million—for Potlatch Corp. in November 1985. That same month, however, the company bought back its shares from the Belzbergs, who agreed to forego any efforts to take over the company for five years. The $46.7 million buy-back, at $43/share, was called greenmail by some observers, but the company said it was part of a broader stock repurchase program that was available to all shareholders.

In July 1986, California investor Paul Bilzerian initiated a hostile takeover bid for Hammermill Paper. The company rejected the $52/share offer—worth $900 million—as inadequate, and it began discussions with other companies about a merger. Bilzerian raised his offer to $57/share, but International Paper put in a higher bid of $64.50/share—worth $1.441 billion—and won control of the company. With its 19% stake, Bilzerian's group collected some $60 million in IP's tender offer. Hammermill has maintained its identity more than most takeover victims. No assets have been sold off, and IP operates it as a separate division.

Early in 1990, Loews Corp., a firm controlled by Laurence Tisch, gained approval from the Federal Trade Commission to buy as much as 15% of Champion International's outstanding shares. The previous December, the paper company sold a $300-million, 8% stake to Berkshire Hathaway Inc., an investment firm headed by Warren E. Buffet. Berkshire Hathaway agreed not to raise its share to more than 18% without prior board approval for a period of ten years. Though it was not a target at the time, analysts indicated Champion made the move to fend off a possible future hostile bid and to raise funds for capital spending.

G-P absorbs GNN. Georgia-Pacific acquired Great Northern Nekoosa in March 1990 in a hostile takeover that stunned the industry because it was the first unfriendly acquisition initiated by a paper company. The proceedings were contentious, with GNN's chairman, William Laidig, saying G-P's $63/share, $3.47-billion cash bid was inadequate and possibly illegal. And the target firm filed a motion in U.S. District Court in Maine seeking a preliminary injunction against G-P's tender offer and proxy contest. Maine's attorney general's office filed an antitrust lawsuit against G-P, though the firm noted that the U.S. Federal Trade Commission had not felt the union of the firms would be a problem. The case was dropped after GNN sought an alternative buyer to repel the takeover once it became apparent its efforts to remain independent would fail.

When no third party stepped forward to intervene, GNN finally agreed to the merger in February 1990 after G-P raised its cash tender offer to $65.75/share. The ultimate value of the transaction was $3.74 billion, and G-P also took on $1.3 billion in GNN debt. The combination created a firm with about $14 billion in annual sales, approximately 30% greater than its closest competitors, International Paper and Weyerhaeuser Co. The new firm would hold about 20% of the uncoated printing/writing paper market, 12% of market pulp, 15% of linerboard, and about 10% of the corrugated box market.

G-P announced it would try to squeeze $160 million to $180 million in savings out of operations over the next three years to lower its debt-to-capital ratio to the 40% to 45% range that existed before the merger. When the acquisition took place, GNN was in the middle of a $575-million project to construct an uncoated free-sheet machine at its Ashdown, Ark., mill.

GNN subsequently said it would not acquire as originally planned a 50% interest in a recycled linerboard mill to be built by Kenaf of North America Inc. In addition, G-P started looking into opportunities to let loose of some units, with analysts expecting their final value to come close to $1 billion. Containerboard mills and corrugated box plants were on G-P's sales list.

RESTRUCTURING THE INDUSTRY

During the back-to-back recessions of 1980 and 1982, several major diversified companies decided to divest their paper industry assets and to invest their money elsewhere. This trend continued into the second half of the decade.

In 1980, Gulf + Western Industries sold its controlling interest in Brown Co. to James River and Pope & Talbot Inc. James River got most of Brown's pulp and paper operations and some timberland, and P&T received two recy-

FOREIGN OWNERSHIP OF U.S. PULP AND PAPER COMPANIES

Company	% owned	Foreign owner	Assets
Alaska Pulp Corp.	100%	Alaska Pulp Co., Japan	Market pulp mill, Sitka, Alaska
Allied Paper Products	100	Hanson Industries, U.S. subsidiary of Hanson Trust, U.K.	Paper mill, Kalamazoo, Mich.
American Fibrit	100	Deutsch Fibrit, Fed. Rep. Germany	Molded pulp products mill, Battle Creek, Mich.
Appleton Papers	100	Batus, U.S. subsidiary of B.A.T. Industries, U.K.	Pulp/paper mills, West Carrollton, Ohio; Roaring Springs, Pa.; Combined Locks, Wis.
Alabama River Newsprint	50	Abitibi-Price Inc., Canada	Newsprint mill, Claiborne, Ala.
Augusta Newsprint Co.	50	Abitibi-Price Inc., Canada	Newsprint mill, Augusta, Ga.
Caraustar Industries	22	Settsu, Japan	Eight paperboard mills in South and Midwest
Cascades Industries	100	Cascades Inc., Canada	Tissue/toweling mill, Rockingham, N.C.
Cascades Niagara Falls	100	Cascades Inc., Canada	Recycled corrugating medium mill, Niagara Falls, N.Y.
Daishowa America	100	Daishowa International, U.S. subsidiary of Daishowa Paper Mfg., Japan	Paper mill, Port Angeles, Wash.
E.B. Eddy Paper Inc.	100	E.B. Eddy Forest Products Ltd., Canada	Lightweight coated paper mill, Port Huron, Mich.
FSC Paper	100	Smorgon Consolidated Industries, Australia	Deinked pulp/newsprint mill, Alsip, Ill.
Golden State Newsprint Co. Inc.	100	Jefferson Smurfit Group, Ireland	Recycled newsprint mill, Pomona, Calif.
Groveton Paper Board	69	SPB Canada, Canada	Paperboard mill, Groveton, N.H.
James River Corp.'s nonwovens business	100	Holzstoff Holding AG, Switzerland	Four nonwovens mills
Keyes Fibre	100	Royal Packaging Industries, Van Leer, Netherlands	Six molded pulp products mills
Leaf River Forest Products	5	Kymmene Stromberg, Finland	Market pulp mill, New Augusta, Miss.
MacMillan Bloedel Inc.	100	MacMillan Bloedel Ltd., Canada	Containerboard mill, Pine Hill, Ala.
Macon Kraft	100	Pratt Holdings, Australia	Linerboard mill, Macon, Ga.
Madison Paper	60	Myllykoski, Finland	Pulp/paper mill, Madison, Wis.
Mohawk Paper Mills	40	Stora Group, Sweden	Paper mills, Cohoes and Waterford, N.Y.
Newton Falls Paper Mill	100	Stora Group, Sweden	Paper mill, Newton Falls, N.Y.
North Pacific Paper	20	Jujo Paper, Japan	Pulp/newsprint mill, Longview, Wash.
Ponderay Newsprint Co.	40	Lake Superior Forest Products Inc., subsidiary of Canadian Pacific Forest Products Ltd., Canada	Newsprint mill, Usk, Wash.
Portals Inc.	100	Portals Ltd., U.K.	Paper mill, Hawkinsville, Ga.
Port Townsend Paper	100	Haindl Papier, Fed. Rep. Germany	Pulp/paper/paperboard mill, Port Townsend, Wash.
Schoeller Technical Papers	100	Felix Schoeller Jr., Fed. Rep. Germany	Paper mill, Pulaski, N.Y.

cled tissue mills in Wisconsin. ITT Corp. in 1980 sold its two British Columbian pulp mills and related forest products operations to Western Forest Products Ltd. ITT put its four U.S. pulp mills and related timberlands on the block, but it could not find a buyer at the reported $3-billion asking price.

In 1982, American Can Co. sold its Dixie/Northern tissue and bleached board operations as well as some timberland to James River. The following year, the company completed its pullout from the industry by selling its Marathon, Ont., pulp mill to James River and by selling its 50% interest in a Halsey, Ore., pulp mill to P&T.

The pace, if not the scale, of divestitures picked up as the recession waned in 1983. Several companies shed their paper-industry assets in favor of less cyclical investments.

In May 1983, Time Inc. announced the spin-off of its Inland Container Corp. and Temple-Eastex Inc. units into a new company, Temple-Inland Inc., so that Time could increase investments in its video and publishing units. In June, Litton Industries Inc. moved to concentrate on its electronics businesses, selling the major part of its Paper, Printing & Forms Group to Technographics Inc. in an LBO worth about $70 million. Also in June, Clevepak Corp. sold its partition mill division and other packaging assets to Rock-Tenn Co. for about $40 million. In August, Phillips Petroleum Co. sold its H.P. Smith Paper Co. unit to James River for $34.5 million.

Efforts to take advantage of better conditions in the paper industry extended into 1984. Sonat Inc. sold its 50% interest in Boise Southern Co. to partner Boise Cascade for $217 million. The U.K.'s Bowater Corp. spun off its North American operations in a tax-free "demerger" that automatically created the largest U.S.-based newsprint producer, Bowater Inc.

In order to expand and to diversify its product lines, Chesapeake Corp. purchased Wisconsin Tissue Mills and Plainwell Paper Co. from Philip Morris Inc. in April 1985 for $214 million. A month later, Philip Morris exited the industry with the sale of Nicolet Paper Co. to Hammermill.

In May 1986, Boise Cascade expanded into the southeastern white-papers market with the $150-million purchase of Allied Paper Inc.'s bleached kraft pulp and paper mill in Jackson, Ala. Boise acquired the mill from Hanson Trust plc, which had picked up Allied in a hostile takeover of SCM Corp. earlier that year. Also in 1986, Times Mirror Co. sold 80% of Publishers Paper to Jefferson Smurfit for $150 million. The deal, Smurfit's first foray into the newsprint sector, included a long-term supply contract for newsprint for Times Mirror publications.

Smurfit was also involved in another big divestiture of 1986: Mobil Corp.'s sale of Container Corp. of America for $1.16 billion to a partnership between Smurfit and a Morgan Stanley investor group. Mobil had owned CCA since 1976.

In mid-1989, Jefferson Smurfit Group plc of Ireland and the Morgan Stanley Leveraged Equity Fund II (MSLEF—the investment affiliate of Morgan Stanley & Co. Inc.) announced a proposal to acquire at $38/share all of the outstanding shares of Jefferson Smurfit Corp. (JSC) not already owned by the Smurfit Group. This was part of a larger scheme by which the Smurfit Group intended to divest a large part of its U.S. holdings, including its 50% share of CCA, to a new company, SIBV/MS Holdings Inc., which would be jointly owned by the Smurfit Group and MSLEF. Then in September 1989, the pair agreed that SIBV/MS Holdings would acquire complete ownership of JSC, which in turn would own 100% of CCA. SIBV/MS Holdings launched a $334-million tender offer at $41.75/share for the 22% of JSC held by the public and paid $1.25 billion at the same share price to Smurfit Group for its 78% holdings. The tender price offered to minority shareholders was ultimately raised to $43.00, and the deal was completed by November.

In the spring of 1990, JSC agreed to buy Keystone Container Corp. of St. Louis, Mo., a corrugated converter, for an undisclosed amount.

Owens-Illinois began the process of exiting from the industry in early 1986, when it agreed to sell its Orange, Texas, linerboard mill and related assets to Temple-Inland for $228 million. After an LBO by Kohlberg Kravis Roberts Inc. in early 1987, O-I's Forest Products Group was sold to GNN in July. Intense bidding for these prime containerboard assets during a period of excellent market conditions helped drive up the price to $1.17 billion—near replacement cost.

Repositioning businesses. Companies inside the industry also have moved to streamline their operations and to rethink their business strategies. The result has been a steady stream of sales and acquisitions as companies shed operations that no longer fit their plans and expand into new areas.

In a major restructuring to focus on its core businesses, Mead ended joint ventures with Temple-Inland and Scott Paper in 1987 and 1988, and it also sold its recycled paperboard business to Rock-Tenn. In the dissolution of the joint ventures, the Georgia Kraft Co. linerboard mill at Macon, Ga., was sold to Pratt Holdings Pty Ltd. of Australia for an undisclosed amount, and Brunswick Pulp & Paper was sold to Georgia-Pacific. The Brunswick mill more than doubled G-P's bleached board capacity, and it doubled the company's export capacity for market pulp.

In a move to concentrate on printing/writing papers, Pentair Inc. sold its Port Huron, Mich., specialty papers mill to E.B. Eddy Forest Products Ltd. of Canada in August 1987. Pentair's other specialty papers mill in Detroit, Mich., was sold in December to Kapaco Group. In early 1989, Eddy sold its Eastern Fine Paper Inc. affiliate in Brewer, Maine, for an undisclosed amount to Preco Corp., the owner of Lincoln Pulp & Paper Co. Inc.

Louisiana-Pacific Corp. took steps in 1987 to distance itself from asbestos liability and to leave the containerboard sector with the spin-off of Fibreboard Corp. The move concentrated L-P's assets in market pulp and forest products. Fibreboard's containerboard division was sold to Gaylord Container for $156 million.

L-P launched a friendly takeover bid in 1988 for Doman Industries Ltd., a British Columbia-based forest products firm. Doman held a stake in Western Forest Products, which was possibly L-P's ultimate target. L-P abandoned the attempt a month later. But in 1989, Doman increased its share in WFP to 56%, putting Doman among Canada's top ten forest products firms. L-P then hiked its share in Doman to 14.7% in mid-1990, fueling rumors that it might make a second run at the company. If L-P managed to acquire a controlling interest in the Canadian firm, it would benefit from Doman's access to British Columbian forestland and sawmill byproducts.

In September 1989, Gaylord Container, which had been rapidly expanding its bag and sack converting operations, acquired U.S. Gypsum Co.'s multiwall bag plant in Oakmont, Pa., on undisclosed terms. Earlier in the year, it had formed a 65%-owned joint venture, Gaylord Bag, to acquire two converting plants. USG, on the other hand, had been divesting units, having sold a gypsum liner mill and its Masonite subsidiary in 1988. USG had taken on $3.1 billion in debt to ward off a hostile takeover from Desert Partners, which subsequently lowered its stake in the company by 1.1% to 4.6%.

Willamette Industries Inc. took the opportunity to get into some new paper products when it bought Penntech Papers Inc. in April 1990. Penntech, which was sold for an undisclosed amount, makes trade book paper, size-press-coated textbook grade, foil laminating, lightweight and medium-weight opaque for financial and other printing, and forms bond.

Boise Cascade put its Vancouver, Wash.-based carbonless and uncoated free-sheet mill up for sale in May, 1990. The plant was the smallest among the company's ten paper mills. The firm intended to refocus on commodity grades, such as coated publication paper and uncoated free-sheet.

Then in August, rumors of a takeover attempt of Boise pushed up the company's stock—at one point, it rose six points to 37. International Paper was the only North American firm named publicly as a potential suitor, though Boise and IP both refused to comment. Other speculation swirled around foreign interest, particularly in Europe, where beneficial tax structures would have been a factor.

Aggressive expansion. Some firms have expanded rapidly by buying assets from companies that want to either leave the industry or streamline their businesses. James River, which began as a one-mill operation in 1969, is a good example of this strategy. It climbed into the top five by purchasing assets divested by companies leaving the industry or sold off after takeovers. After the Brown deal with Gulf + Western in 1980, James River more than doubled its size with the 1982 purchase of American Can's paper-industry assets for $446 million. This further integrated James River into pulp production and made it a major national producer of tissue and folding cartons.

In 1983, the company paid $172 million for Diamond International's pulp and papermaking assets, adding to its white papers capacity and extending its tissue and towel business in the Northeast. In 1986, James River moved into the top five among paper companies with the purchase of Crown Zellerbach's paper operations for $1.43 billion.

The company also expanded in the international market, particularly in Europe. In 1987, James River bought 50% of the Kaysersberg Div. of French papermaker Beghin-Say for $243 million. Kaysersberg's tissue and nonwovens business will be used as a platform for expansion in Europe. This purchase was followed in 1989 by the $77-million acquisition of the tissue operations of Buhrmann-Tetterode N.V. of the Netherlands, which were to be part of a joint venture with Nokia Corp. of Finland and Ferruzzi of Italy.

However, some analysts felt the resulting James River was a bit unmanageable. Its nonintegrated mills and the run-up in pulp prices were a liability, and the CZ mills exposed James River to rising wood costs in the Pacific Northwest.

James River ultimately announced in August 1990 that it would shed $1.3 billion in assets in the U.S. and the U.K.—about 20% of company capacity. The restructuring would result in a $140-to-$150-million charge and a net loss in the first quarter, ending July 29. Funds generated by the sales were intended for debt reduction, repurchase of up to 1 million shares of common stock, and strategic expansion.

About 30 mills and converting plants were involved in the plan. Their closure or divestiture would leave the company focused on more profitable sites for towels and tissue, Dixie food service products, food and consumer packaging, and communication papers. Earlier in the year, the firm announced it would sell its nonwovens group to Holzstoff Holding AG for $175 million. Simpson Paper was expected to pick up James River's coated and uncoated printing and publishing papers mill in West Linn, Ore., by year end. And the specialty papers businesses were due to be bought by AEA Investors Inc. and a management group headed by James Rogers, group executive for that paper unit at the time. James River was to retain a 20% interest in the new company. Various business papers and towel and tissue mills were also on the block.

Stone Container more than doubled its capacity in 1983 with the purchase of Continental Forest Industries' Brown System operations for $510 million. In 1986, Stone purchased most of the packaging operations of Champion International for $457 million after Champion's merger with St. Regis. The deal made Stone the world's largest producer of unbleached kraft packaging products. The company added to its containerboard capacity with the purchase and reactivation of the former Jacksonville Kraft Co. mill at Jacksonville, Fla., in a partnership called Seminole Kraft Corp. Stone also completed a friendly merger with Southwest Forest Industries in 1987 for $760 million, adding another linerboard mill and branching out into newsprint.

The majority of recent deals have involved papermaking assets, but a few firms have looked outside the industry for expansion opportunities. One example is Fort Howard, which paid $500 million in 1983 for Maryland Cup Corp., a maker of disposable packaging products for the commercial and industrial market. In 1986, the company expanded its cup market share from about 18% to 31% with the purchase of Lily-Tulip Inc. for $326 million. The deal moved Fort Howard ahead of James River's Dixie-Northern operation and into first place in the sanitary-food-container sector.

But toward the close of 1989, Fort Howard sold its U.S. and Canadian cup operations to Sweetheart Holdings Inc., a new company controlled by the Morgan Stanley Leveraged Equity Fund II and a private investor group led by D. Greg Horrigan and R. Philip Silver, the chairman and president, respectively, of Silgan Corp. Morgan Stanley controlled about 70% of the privately held Fort Howard stock. Fort Howard recieved $322 million in cash, $210 million in bridge notes and subordinated debt securities, and 49.9% of Sweetheart's initial shares. Much of the cash was used to retire bank debt incurred in Fort Howard's LBO the previous year. At the time, Fort Howard was still looking into selling its European and Asian disposable food service operations.

In July 1988, Stone Container bought Trinity Paper & Plastics Corp., a major independent grocery sack converter. Stone planned to combine Trinity with its Retail Bag operations and then divide that into multiwall packaging and flexible packaging. In 1989, Pope & Talbot bought four disposable diaper manufacturing plants from Georgia-Pacific for an undisclosed amount.

Howard Paper Mills Inc. ended its year-long tenure in the "for-sale" market in the second half of 1989, going to an investor group led by former Manville Forest Products Corp. president Harry Sherman. No sales price was disclosed for the printing and writing paper firm.

Early in 1990, Amcor Ltd. completed the purchase of Sunclipse Inc., a major independent West Coast corrugated converter and paper distributor. Amcor bought just under half of Sunclipse's shares in 1989 for $90 million and picked up the rest the next year for $105 million.

In August 1990, Inland Container agreed in principle to buy Crockett Container Corp. and Pakway Container Corp., raising the number of Inland's corrugated box plants by seven to 40. Annual sales of the two converters totaled about $115 million.

Leveraged buyouts surge. In an LBO, a small group of investors—often composed of company management—finances an acquisition through loans secured by the assets being purchased, and the loan is then repaid from funds generated by company operations or the sale of company assets. LBOs had been used successfully to finance paper-industry acquisitions through much of the 1980s, but funds were became tighter in later years.

The main reason for the popularity of LBOs was the opportunity for great profit. For example, Ecusta Corp. was taken private for $130 million in 1985 in a buyout from Olin Corp.; in 1987, Ecusta was sold to P.H. Glatfelter Co. for $219 million. LBOs have also been used to escape hostile takeovers. National Gypsum Co. went private in 1986 in a $1.1-billion buyout to escape a takeover attempt by the Canadian investor Samuel Belzberg.

The biggest name in the LBO industry is Kohlberg Kravis Roberts. In 1987, KKR bought out Owens-Illinois and Jim Walters Corp. for $3.66 billion and $2.44 billion, respectively. In both cases, paper industry assets were sold off to help finance the deals. Great Northern Nekoosa was the buyer in both cases, purchasing O-I's Forest Products Group in 1987 for $1.17 billion and Jim Walters Papers in 1988 for an undisclosed sum.

The huge debts incurred in such transactions can adversely affect the final outcome of these strategic investments. The Fort Howard LBO in late 1988 rang up the biggest bill to that time for any acquisition in the North American pulp and paper industry. The weight of that debt and softening profits led to Fort Howard's putting the cup business up for sale in 1989.

Foreign interests. A significant number of recent acquisitions in the U.S. paper industry have been made by foreign companies. The portion of foreign investment seems to have risen in recent years as domestic funds have shrunk. The Japanese made their first direct purchase of a U.S. paper mill only in 1987, when Daishowa America Co. Ltd. purchased an uncoated groundwood paper mill at Port Angeles, Wash., from James River for $75 million. Daishowa and Louisiana-Pacific had announced in February 1987 that Daishowa would buy Fibreboard Corp. for $160 million, but the deal fell through for unexplained reasons in June 1987.

Also in 1987, Settsu Corp. of Japan acquired a 21.5% interest in Caraustar Industries Inc., the fourth-largest U.S. producer of recycled paperboard. Settsu, Japan's largest recycled board producer, purchased the stake to give it a presence in the U.S. market.

Australians were also active in the U.S. market in 1987. FSC Paper Corp. was sold to Smorgon Consolidated Industries Pty Ltd. in May. Smorgon, a recycled containerboard producer based in Melbourne, said it purchased the mill as a stepping stone into the U.S. market. In July, a little-known Australian company called Pratt Holdings Pty Ltd. acquired the Macon, Ga., mill of Georgia Kraft Co. for an undisclosed amount.

In 1990, Jefferson Smurfit Group plc of Ireland picked up Golden State Newsprint Co. Inc. and Pacific Recycling Co. from the Giant Group Ltd. for $95 million in cash and a further $25 million if Golden State went ahead with a second recycled newsprint machine.

Many U.S. companies are also looking more closely at European investments before trade barriers within the Common Market countries are eliminated in 1992.

International Paper, Federal Paper Board, James River, and Stone Container are among the more aggressive purchasers in Europe, according to Shearson Lehman Hutton.

Federal Paper Board early in 1989 acquired Scottish white-paper producer Thomas Tait & Sons Ltd., which sells its own papers in Europe. Besides giving Federal a manufacturing presence in the Common Market, the acquisition expanded the company's production base and reduced its exposure to price fluctuations in the pulp market.

Also in 1989, Scott acquired Cross Paperware in the U.K. for about $26 million. International Paper bought Aussedat Rey SA for Fr2.03 billion. Late in 1989, International Paper picked up 51% of the voting common shares of Zanders Feinpapiere AG—one of West Germany's leading paper companies—from J.W. Zanders KG, a family-owned holding company. Although the purchase price was not disclosed, the West German firm's 1988 sales reached $545 million. It was anticipated that IP would later try to hike its share in the business to 76%, giving it total control of Zanders. Excluding this transaction, IP had pumped over $2.7 billion into 13 acquisitions over the past three years.

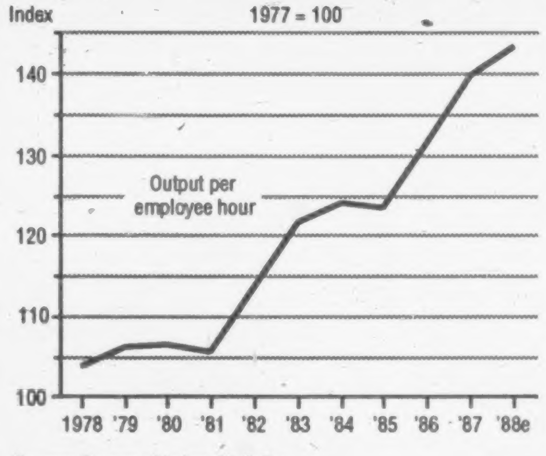
United States:

LABOR

Most organized American paper industry workers are represented by the United Paperworkers International Union (UPIU AFL-CIO), based in Nashville, Tenn. It is the largest North American paperworkers' union, representing over 235,000 employees across the U.S. and about 2,500 workers in central Canada. UPIU is headed by Wayne E. Glenn, 66, who has served as president since 1978. The Association of Western Pulp & Paper Workers (AWPPW), based in Portland, Ore., represents approximately 15,400 workers, mainly in the Pacific Northwest. The independent union is headed by President Farris Bryson, who was elected in 1976. Smaller numbers of pulp and paper workers are represented by other unions. A virtually untapped source of membership for the paperworker unions remains to be the paper converting industry.

UPIU was formed in 1972 by the merger of the United Papermakers and Paperworkers and the International Brotherhood of Pulp, Sulphite, and Paper Mill Workers. AWPPW had broken from the Pulp, Sulphite, and Paper Mill workers in 1964. The Canadian Paperworkers Union broke from UPIU in 1974. Glenn's term of office at UPIU

PRODUCTIVITY OF PRODUCTION WORKERS AT PULP, PAPER, AND BOARD MILLS



Source: Bureau of Labor Statistics.

U.S. PAPER AND ALLIED PRODUCTS EMPLOYMENT AND EARNINGS, 1965-88

Year	All employees (000)	Production workers (000)	Average hourly earnings	Average weekly earnings
1988	689.1	521.6	$11.64	$502
1987	679.0	515.7	11.43	496
1986	673.7	511.0	11.18	483
1985	677.7	512.1	10.83	467
1984	680.9	511.6	10.41	449
1983	661.2	494.5	9.93	423
1982	662.4	493.9	9.32	390
1981	688.5	518.4	8.60	366
1980	692.8	522.7	7.84	331
1979	706.8	535.6	7.13	304
1978	698.7	524.7	6.52	280
1977	691.6	518.2	5.96	256
1976	675.5	508.3	5.47	232
1975	642.0	479.7	5.01	208
1974	706.1	544.3	4.53	191
1973	704.6	543.1	4.20	180
1972	688.9	531.6	3.95	169
1971	681.9	521.8	3.67	155
1970	705.5	543.2	3.44	144
1965	639.1	497.7	2.65	114

Source: Bureau of Labor Statistics.

ends in 1992, and he is eligible to serve until 1996. AWPPW will hold its next convention to elect officers in September 1991.

Due to declining membership and employment, as well as the ability of employers to operate mills with salaried workers and replace striking work forces, unions have been unable to wield as much power as in the past. Company insistence on cost-cutting measures to remain competitive have resulted in unions agreeing to modest wage increases and other contract concessions. The U.S. paper industry saw only one strike in 1989, compared with 19 in 1983 and 16 in 1986. In the first nine months of 1990, two strikes occurred, both by AWPPW in the Pacific Northwest.

The elimination of Sunday premium pay for paper workers continued through 1989, with over 100 mills having discontinued the policy by mid-1990. AWPPW said it has yet to ratify a contract that eliminates Sunday premium pay, although union members are working under implemented contracts that contain the provision. While market pressure increases on other mills to follow suit, companies that have eliminated Sunday premium are now attempting to cut costs by redesigning work practices and job descriptions. Major developments in 1990 labor negotiations included the declining use of lump-sum payments in substitution of a first-year wage increase and a dramatic increase in four- and five-year contracts.

The lump-sum practice was beneficial for companies both for maintaining a lower base wage and for reducing the multiplied effect on benefits and pensions in any one year. At some facilities, a general wage increase was replaced by a percentage increase based on W-2 earnings. Some mills were able to eliminate holidays and shift differentials. On the surface, average first-year wage increases went up in 1990 to 2.4% compared with 1.1% in 1989, but the low 1989 figure was due to the proliferation of lump-sum payments, which sometimes amounted to 3% of annual wages, noted industry analyst Julian Kien.

"In the last year, we held our own," said a UPIU executive. "The gains were not what we would consider to be fair, but it was an improvement." He emphasized improved attitudes among certain companies, namely Scott Paper Co. and James River Corp., two producers who established high-level labor management committees with UPIU. "We've developed a working relationship with them, and it is reflected at the bargaining table," the UPIU executive said. But companies such as International Paper Co. and Georgia-Pacific Corp. still draw the ire of union officials.

"Unfortunately, things haven't improved one iota with IP," the union leader said. "And G-P. and Stone Container Corp. are still in the same position. There are no realistic proposals."

HOURLY EARNINGS OF U.S. PAPER AND ALLIED INDUSTRY PRODUCTION WORKERS, 1983-88

	1988	1987	1986	1985	1984	1983
Paper and allied products	$11.78	$11.53	$11.14	$10.82	$10.41	$9.93
Paper and pulp mills[1]	14.48	14.09	13.59	13.13	12.43	11.70
Paperboard mills	14.59	14.47	14.00	13.60	12.99	12.11
Misc. converted paper products	10.10	10.04	9.58	9.32	9.09	8.71
Paperboard containers/boxes	10.03	9.91	9.54	9.23	8.92	8.60
All U.S. manufacturing	10.37	10.07	9.73	9.53	9.19	8.83

n.a. = Not available.
1. Includes construction paper/board mills.
Source: Bureau of Labor Statistics.

TOTAL U.S. PAPER AND ALLIED PRODUCTS INDUSTRY EMPLOYMENT BY SEGMENTS, 1982-88

(000 employees)

	1988	1987	1986	1985	1984	1983	1982
Paper and allied products	690.7	684.8	673.7	677.7	680.9	661.2	653.0
Paper and pulp mills[1]	191.4	191.2	195.2	197.0	200.0	198.0	196.6
Paperboard mills	52.9	53.7	53.3	55.3	57.2	58.2	59.5
Misc. converted paper products	237.4	233.4	229.5	228.5	226.5	214.4	208.4
Paperboard containers/boxes	211.5	206.5	196.3	196.9	197.2	190.6	188.5

1. Includes construction paper/board mills.
Source: Bureau of Labor Statistics.

UNION CONTINUES POOLING EFFORTS

Specifically aimed at the large, integrated, multi-facility companies, pooling is designed to control ratification of contracts by putting all facilities up for negotiation at the same time. UPIU employed this tactic during its 1989-90 bargaining with Champion International Corp. In early 1990, UPIU set up a pool among 25 locals of IP, saying it expected the pool to grow to 100 locals by late 1991. AWPPW also has several multi-mill "units" in the Northwest. But the National Labor Relations Board has consistently ruled against attempts at coordinated bargaining so far. The threat of striking workers being permanently replaced by temporary employees has loomed over the unions, especially since the IP strikes of 1988. But in over 115 strikes since 1980, only a handful of mills have replaced its union work force. Unions seem more limited by the technical ability of a company to operate its mill using salaried personnel.

In February 1989, over 400 members of AWPPW returned to work at Smurfit Newsprint Corp.'s Oregon City and Newburgh, Ore., mills after a seven-month strike over medical and pension benefit issues. The only strike of 1989 happened in March at Little Rapids Corp.'s Potsdam (N.Y.) Paper Mill, where 100 members of UPIU were replaced by nonunion workers.

In 1990, more than 400 AWPPW members at G-P's Toledo, Ore., linerboard mill struck for almost three months over the company's efforts to eliminate Sunday premium pay and reduce vacation pay. A two-year accord was reached in May after G-P announced plans to sell the operation as part of a restructuring effort. Then in late August, about 270 AWPPW workers struck at ITT Rayonier Inc.'s pulp mill in Hoquiam, Wash., in a union effort to eliminate a two-tier wage and benefit structure.

Union workers also flexed their muscle at Boise Cascade Corp.'s International Falls, Minn., pulp and paper complex, where members of several trade unions opposed the company's use of nonunion contractor BE&K Inc. in a $535-million mill expansion project. After an initial wildcat strike, over 400 protesting union members rioted Sept. 9, 1989, causing over $1.3 million in damage.

Negotiations involving over 6,000 Champion International workers dragged on through late 1989 and much of 1990, with five of seven mills eventually reaching accords as part of a UPIU pooled voting effort. But with two mills, Sartell, Minn., and Courtland, Ala., still unable to reach agreements with the company, the pool disintegrated in October, and implementation continued at the holdout locations.

LONGER SETTLEMENTS INCREASE STABILITY

Average first-year wage increases of 2.4% in the paper industry continue to be below the 3.0 average of the U.S. manufacturing sector. Analyst Kien noted that labor agreements are becoming longer, with 60% of pacts in the first nine months of 1990 being for four or more years. In 1987, 10% of contracts were for four years or more. Of the 62 mills that settled through October 1990, one-third were for five or more years. The long-term impact of contract extensions will be moderation in wage escalation as those increases in 1992 through 1994 continue at established levels and the accords create a stable work environment in the face of the industry's cyclical downturn, Kien said.

Among notable five-year settlements in the U.S. in 1989 and 1990 are accords reached at James River in Green Bay, Wis., and Naheola, Ala.; a five-mill unit of Weyerhaeuser Co. in Washington and Oregon; two former Great Northern Nekoosa Corp. mills at Millinockett and East Millinockett, Maine; and Rayonier's Jesup, Ga., mill. G-P reached a five-year contract at Woodland, Maine, in December 1989, more than two years after the previous contract expired. But through 1989 and 1990, implemented contracts lingered at several IP locations as well as at Louisiana-Pacific Corp.'s Ketchikan Pulp Co. in Alaska, where 150 AWPPW workers have been without a ratified contract since 1985.

AVERAGE FIRST-YEAR WAGE INCREASES IN U.S. PULP AND PAPER INDUSTRY, 1979-90

Year	New England	East	Midwest	South	Pacific	Total U.S.
1990*	1.3%	2.4%	2.5%	3.1%	2.8%	2.4%
1989	1.2	2.0	1.5	1.0	0.0	1.2
1988	0.4	1.9	1.1	0.2	0.5	0.9
1987	0.3	1.3	0.6	0.1	0.0	0.4
1986	1.0	0.6	0.5	0.1	0.2	0.3
1985	2.3	3.4	3.2	1.6	-1.1	2.1
1984	4.9	4.3	4.6	5.3	-0.9	3.3
1983	5.8	5.2	5.1	5.9	1.3	5.6
1982	7.3	6.7	6.6	6.8	7.7	6.9
1981	8.8	9.0	8.5	8.2	9.0	8.7
1980	10.7	9.8	9.3	8.7	9.8	9.2
1979	9.6	9.4	9.5	10.0	10.0	9.6

*Through October.
Source: American Paper Institute.

U.S. PAPER WORKERS UNIONS

Union	Region represented	Members: Total	Members: Primary pulp and paper
United Paperworkers International Union	U.S.	237,000*	54,000
Assn. of Western Pulp & Paper Workers	Pacific Northwest	15,400	15,400

*Includes approximately 40,000 employed in areas such as chemicals and hospitals. International Assn. of Machinists & Aerospace Workers, International Brotherhood of Electrical Workers, and other major unions also have representation at U.S. mills.

As negotiations involving about 80 pulp and paper industry locations come up during 1991, companies are hotly pursuing cost containment in health care coverages. Health care expenses are estimated to consume 45% of business operating profits, and the heath care rate of inflation in 1990 was almost double the consumer price index. Average annual health plan costs per employee come to about $2,350, leading paper companies to put controlling health insurance costs at the top of their bargaining agenda in the coming year.

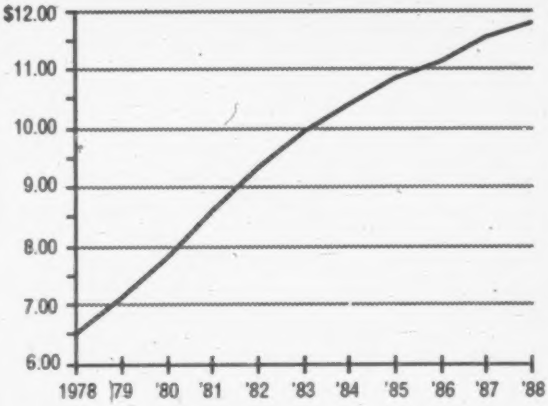
PRODUCTIVITY INDEXES FOR U.S. PAPER AND ALLIED PRODUCTS

(output per employee hours; 1977 = 100)

Year	Production workers	All employees
Pulp, paper, and board mills		
1988e*	143.2	139.8
1987	139.8	136.4
1986	131.4	128.8
1985	123.6	122.2
1984	124.0	121.9
1983	121.4	119.6
1982	113.7	111.3
1981	105.5	104.4
1980	106.4	105.2
1979	106.2	105.4
Average annual percent change 1979-85	3.3%	3.2%
1978	103.7	103.2
1977	100.0	100.0
1976	95.0	95.0
1975	87.7	86.7
1974	90.5	91.5
1973	90.2	91.5
1970	75.8	77.5
1960	48.8	50.6
1954	37.9	40.4
Average annual percent change 1947-85	4.1%	3.7%
Corrugated and solid fiber boxes		
Average annual percent change		
1958-85	4.0%	3.7%
1973-85	2.6%	2.5%
Folding paperboard boxes		
Average annual percent change		
1963-85	1.9%	1.8%
1973-85	0.6%	0.6%

*American Paper Institute data.
e = Estimate.
Source: Bureau of Labor Statistics.

AVERAGE HOURLY EARNINGS OF PRODUCTION WORKERS



Source: Bureau of Labor Statistics.

REPRESENTATIVE BASE-WAGE RATES FOR REGIONS OF NORTH AMERICA, 1970-90

	U.S.		Canada	
Year	South	West	Eastern	B.C.
1990	—	—	C$16.22	C$17.07
1989	—	—	15.37	16.17
1988	—	—	14.71	15.33
1987	$13.59*		14.26	14.48
1986	—	—	14.01	14.09
1985	—	—	13.34	14.09
1984	9.51	11.22	12.83	13.48
1983	9.07	11.19	12.52	12.96
1982	8.56	11.05	11.38	12.96
1981	7.91	9.37	10.16	11.46
1980	7.28	8.53	9.23	9.96
1979	6.74	7.90	7.89	9.06
1978	6.13	7.25	7.46	8.16
1977	5.57	6.59	6.99	7.61
1976	5.04	5.96	6.47	6.89
1975	4.58	5.26	5.88	6.14
1974	4.15	4.78	4.57	5.10
1973	3.78	4.32	4.21	4.45
1972	3.48	4.02	3.85	4.09
1971	3.28	3.76	3.51	3.80
1970	3.09	3.45	3.25	3.50

*National average.
Source: *Pulp & Paper Week.*

United States:

TIMBER RESOURCES AND PULPWOOD COSTS

Forests cover about one-third of the U.S., amounting to 737 million acres, according to the American Forest Council. The growing stock in those forests has actually been increasing over the years, rising from 603 billion ft^3 in 1952 to 830 billion ft^3 last year.

Roughly one-third of the acreage either is not usable for tree farming or has been reserved for parks or wilderness. The other two-thirds of the land is known as commercial forest. About 4 million private landowners hold 58% of it, AFC said. Twenty-eight percent is publicly held, primarily by the U.S. Forest Service, and the forest products industry retains the remaining 14% of the land, though it is responsible for 30% of the national forest harvest. Private, nonindustrial landowners provide 48% of that harvest, according to AFC, and government lands supply the rest.

Pulpwood consumption in 1989 hit 98.4 million cords, the American Pulpwood Assn. reports, up from 95.5 million in 1988. A cord of wood 4 x 4 x 8 ft yields 1,000 to 2,000 lb of paper, according to AFC. Each American's wood and paper demands require a 100-ft tree per year.

Washington, Oregon, and California produce the most timber. In fact, half the lumber used in the U.S. comes from the Pacific Northwest. The nation relies on the South and Canada for much of the rest.

In the Pacific Northwest, preservation of old-growth national forests and exports of raw logs to more lucrative overseas markets, such as Japan, both have been squeezing supplies of wood and chips for the domestic pulp industry. That has had a dramatic effect on prices. For example, Douglas fir chip exports from the West Coast to Japan that cost $86.70/bdu f.o.b. vessel in second-half 1988 jumped to $133/bdu a year later.

Some sawmills closed as more raw-log processing was done overseas and pulp mills stockpiled chips as supplies became more uncertain. Congress turned to bans on timber exports in an attempt to retain enough raw wood in the region to keep local sawmills in business. This has been controversial because some observers say most of the log exports going to Japan are second-growth timber, and the domestic sawmills facing permanent closure can process only old-growth logs.

States have not succeeded in enforcing such export bans by themselves. Oregon, California, Idaho, and Alaska each set up laws limiting timber exports from state lands. But in 1984, the U.S. Supreme Court struck down the Alaskan law on the grounds that states cannot regulate trade policy.

Senator Robert Packwood (R-Ore.) came up with a measure to straighten out the conflict. The measure, which

U.S. DEMAND FOR TIMBER PRODUCTS, 1986-2040

Product	Standard unit of measure	Consumption 1986	Projected demands—medium level 2000	2040
Lumber	Billion bd ft	56.8	55.2	69.4
Plywood	Billion ft^2, $^3/_8$-in. basis	23.5	20.7	27.3
Board*	Billion ft^2, $^3/_8$-in. basis	20.1	27.9	38.1
Pulpwood (U.S. mills)	Million cords	92.1	112.3	158.2
Other industrial products	Billion ft^3	0.5	0.8	1.4
Fuelwood (roundwood)	Billion ft^3	3.3	4.3	5.1
Total roundwood, sawtimber	Billion ft^3	20.5	22.9	28.6

*Includes particleboard, insulating board, hardboard, oriented strand board/waferboard.

Source: U.S. Forest Service, "An Analysis of the Timber Situation in the U.S., 1950-2040," 1990.

was passed by the Senate in 1990, would direct the Secretary of Commerce to enforce bans on exports of timber harvested from state land in any state that passes such a ban. That would not help Washington any time in the near future, as state officials expect it could take a year and a half to pass and impose a ban there. Governor Booth Gardner instead is seeking an immediate federal ban. Washington shipped 455 million bd ft of raw timber from state lands in 1989, while Oregon exported 98 million bd ft.

Packwood's measure also would make permanent a ban on timber exports from federal lands that has been renewed each year beginning in the 1960s. And the legislation would prohibit substitution, a practice by which a company buys federal timber to replace privately owned timber shipped overseas.

The House Foreign Affairs Committee passed its own version of log export legislation, and it went through the House Interior Committee and an agriculture subcommittee earlier this year. Like the Senate measure, the House legislation would put a permanent ban on the export of federal logs. It would phase out direct substitution and limit indirect substitution. States harvesting 400 million bd ft or less of state timber would be prevented from exporting logs from state lands. States cutting more than that would have to retain either 400 million bd ft or 75% of the harvest from state lands—whichever is larger.

Congressional action has not been limited to trade. The Senate passed a bill in mid-1990 to limit logging in Alaska's Tongass National Forest, to modify long-term harvesting contracts in the area, and to protect 673,000 acres as wilderness. Congress has already protected 5.4 million acres of the 16.7-million acre forest as wilderness, but interest in the issue continues because Tongass is one of the few temperate rain forests left in the world.

Last year, the House passed a stricter version of the Tongass bill that would cancel the long-term logging contracts outright and put future timber sales up for competitive bidding. It would also set aside 1.8 million acres as wilderness.

In Washington state, Mount Baker-Snoqualmie National Forest is also being targeted for harvest cutbacks. The federal government has suggested that the average annual harvest there be lowered 46% to 108 million bd ft, potentially leading to the loss of 1,800 jobs in the area.

Washington and Alaska are not alone. The U.S. Forest Service plans to reduce harvesting within national forests to 10.8 billion bd ft by 1995, compared with the average of 12 billion bd ft cut each year in 1983-88. Also, the amount of clear-cutting permitted will drop by half. By the year 2040, harvests will be allowed to rise to 12 billion bd ft.

While the harvest plans and the proposed timber export bans have spawned some disagreements, the northern spotted owl has been the most divisive timber supply issue of late. The owl possibly serves as an indicator species for the general health of old-growth forests. It has been a focal

U.S. PULPWOOD RECEIPTS

(000 standard cords, roundwood basis)

Year	Total receipts	Softwoods	Hardwoods
1989	97,016	67,096	29,920
1988	95,063	65,806	29,257
1987	93,890	65,295	28,595
1986	90,623	63,305	27,319
1985	85,349	60,207	25,142
1984	88,035	62,858	25,177
1983	82,390	58,959	23,431
1982	73,541	56,387	20,887
1981	79,336	58,818	20,517
1980	81,007	60,170	20,837
1979	76,928	57,439	19,489
1978	74,824	55,567	19,257
1977	72,867	55,389	17,479
1976	72,265	54,433	17,831
1975	65,456	49,280	16,175
1974	77,103	56,189	20,194

Source: Bureau of the Census, "Current Industrial Reports Series MA26A."

U.S. PULPWOOD RECEIPTS BY REGION

(000 cords, roundwood and residues)

Year	Total	Northeast	North Central	South Atlantic	South Central	West
1989	99,279	7,242	7,020	31,982	35,840	17,196
1988	95,547	7,187	6,865	31,582	33,761	16,152
1987	93,835	6,962	6,555	30,492	33,644	16,182
1986	89,396	7,277	6,574	28,875	31,054	15,616
1985	84,878	7,430	6,429	27,398	29,362	14,259
1984	88,713	7,879	6,873	27,570	30,893	15,498
1983	82,466	7,087	5,945	25,532	28,915	14,987
1982	78,319	7,095	5,585	24,467	26,348	14,835
1981	81,108	7,459	5,639	25,356	27,744	14,910
1980	81,008	7,159	5,970	25,511	25,872	16,497
1979	78,625	7,461	5,630	26,126	26,654	12,754
1978	76,138	6,179	5,302	25,353	25,572	13,732
1977	73,774	5,887	5,464	22,834	24,652	14,937

Source: American Pulpwood Assn.

point for environmentalists, who want to preserve such timber and the species dependent upon it, and for loggers, who want to preserve their jobs.

In 1989, environmentalists intent on saving the owl managed to get court injunctions preventing the harvest of 2.5 billion bd ft of federal timber. Congress then passed the Hatfield-Adams "timber compromise" legislation in October 1989, releasing about half of that timber, though the compromise pushed harvest levels for 1989-90 20% below those for 1987-88. For fiscal 1989 and 1990 combined, the compromise legislation allowed for the sale of 7.7 billion bd ft of timber by the Forest Service and 1.9 billion bd ft by the Bureau of Land Management (BLM) in the Northwest, though the agencies would have to take steps to protect old-growth forests. Overall, the Forest Service managed to offer only 2.4 billion bd ft for sale in fiscal 1989 in the region, leaving most of the harvesting for fiscal 1990.

Much of the shortfall last year was made up by sales from private lands. But Evadna Lynn, analyst with Dean Witter Reynolds, said that resource will dry up, since many blocks have already been liquidated and private owners are reducing their harvest plans. To make matters worse, environmental groups sued to overturn the compromise. And in California, proposed initiatives could shrink harvests from government and private lands by 10% to 40% if passed.

In mid-1990, the U.S. Fish and Wildlife Service designated the northern spotted owl a threatened species. But a full-fledged plan to protect the owl by severely limiting logging in its habitat in the Pacific Northwest proved too much for the Bush administration to stomach, and it sought another compromise to reduce the loss of forest-related jobs. The plan will have little impact on this fiscal year's harvest on BLM lands, ending Sept. 30, but next year, the harvest will drop 150 to 200 million bd ft from 950 million expected to be sold this fiscal year. The government said this would preserve 450 pairs of owls and displace just 1,000 workers vs 7,600 jobs that could have been lost under a more restrictive plan suggested by government agencies earlier in the year.

The fiscal 1991 harvest from Forest Service lands was not addressed in the new plan, however. That will be left to a panel to be chaired by Agriculture Secretary Clayton Yeutter. The panel must make recommendations to President Bush by Sept. 1.

In anticipation of a restricted timber supply, pulp mills in the Pacific Northwest built up huge stores of chips as security. Inventories on the West Coast rose from roughly 1 million bdu to about 2 million bdu over just ten months last year. The pulp industry also moved to protect itself from rising chip prices by building satellite whole-log chipping plants to ensure supplies.

And private landowners who did not own mills moved to liquidate their assets in this seller's market. Critics said they were overcutting in their rush to rake in a profit or to pay off debt and were stripping the forests faster than they could be regenerated. In Washington, for example, harvesting by these owners jumped from 800 million bd ft in 1979 to 1.5 billion in 1988. Overall, private lands supplied 4.4 billion bd ft that year, up from 4 billion in 1979.

Champion International Corp. announced plans in spring 1990 to sell 206,000 acres of timberland in California to fund capital projects. Logs from these lands had been used mainly for export. Champion values its entire landholdings at an average of about $270/acre, but analysts believe the land being sold could be worth more, based on recent quotes on other properties. Earlier in the year, for example, Pope & Talbot Inc. put 37,000 acres of Oregon timberland on the market for $40 million, or $1,081/acre. And last year, Scott Paper Co. sold 194,000 acres in western Washington for about $230 million, or $1,185/acre.

Timber costs by mid-1989 were quite high. Some sales were over $600/1,000 bd ft on the stump—not including the cost of logging, hauling, and milling, according to Chuck Lewis, editor of *Wood Fibre Northwest*. This was more than some grades of lumber could bring in. *Paper-Tree Letter* noted that sawmills in the region were bidding an average of $365/1,000 bd ft in first-quarter 1989, nearly three times as much as the average price in 1985.

By October 1989, the chip business began to weaken in response to the massive inventories built up in the face of

U.S. PULPWOOD CONSUMPTION

(000 cords)

Year	Total consumption	Northeast	North Central	South Atlantic	South Central	West
1989	98,414	7,072	6,963	32,239	35,791	16,349
1988	95,497	7,216	6,929	31,567	33,646	16,139
1987	93,946	7,109	6,764	30,915	33,059	16,093
1986	91,434	7,226	6,730	29,425	32,113	15,939
1985	85,557	7,358	6,304	27,763	29,887	14,245
1984	87,621	7,474	6,563	27,292	30,529	15,763
1983	85,442	7,274	6,343	25,847	29,152	16,826
1982	76,257	6,695	5,419	24,054	26,652	13,417
1981	81,178	7,025	5,762	25,494	27,627	15,270
1980	79,703	7,318	5,714	24,960	26,246	15,465
1979	77,362	6,749	5,729	24,427	25,419	15,038
1978	74,170	6,501	5,492	23,701	25,119	13,357
1977	73,970	5,949	5,473	22,817	24,468	15,063
1976	73,209	5,777	5,442	22,673	24,969	14,247
1975	65,421	5,417	4,779	19,983	22,042	13,200
1974	74,459	6,149	5,678	22,926	24,240	15,466

Source: American Pulpwood Assn.

these difficult market conditions.

Northern California pulp mills' expenses for Douglas fir dropped $15 to $25/bdu from $100 to $125, beginning in October. Tabs in Oregon, excluding the Columbia River Valley, were down $5 to $10/bdu. In the Valley, prices went back to second-quarter levels.

Douglas fir chips in northern California dropped again in the middle of fourth-quarter 1989. Prices ranged from $65 to $75/bdu inland and were $85/bdu near the coast. In the Columbia River Valley, tabs fell $5 to $10/bdu in December to $100/bdu.

Growth in woodchip reserves in the U.S. leveled out at year end, and by the end of first-quarter 1990, the swollen inventories had begun to shrink, though prices continued to drop. Second-quarter softwood chip prices dropped $10/bdu in California and Oregon and perhaps $15/bdu further north in the Columbia River area, partly as a result of strikes and shutdowns at consumers' facilities.

Douglas fir chips delivered in the Eugene-Springfield region were selling at $65 to $95/bdu at the end of the first quarter and at $80 to $102 in Longview, Wash., according to *Wood Fibre Northwest.* But although further softening was expected, shortfalls could crop up by the end of the year or early next year because of conservation efforts. Some suppliers were hoping to wait out the soft market by leaving felled trees in the woods.

The drop in export prices lagged that for domestic markets. Second-half 1989, Douglas fir chip exports jumped $15/bdu from the previous quarter to $133/bdu f.o.b. vessel and were $33.50/bdu higher than in the first quarter. Second-half 1989 tabs for red alder increased somewhat less dramatically, hitting $124.50, a hike of $7.50 from the second quarter.

Pacific Northwest export chip tabs for the first half of 1990 were set at $117/bdu f.o.b. vessel for Douglas fir chips and $114/bdu f.o.b. vessel for red alder. Spruce-pine-fir exports brought in $118.50/bdu f.o.b. vessel. Tabs weakened in the second half as Japanese buyers worked some excess finished product inventory out of their businesses. Douglas fir chips were set at $109.40, and spruce/pine/fir at $111 for the third quarter. Red alder dipped to $113.

This year's woodchip exports to Japan should bring in $434 million, vs $347 million last year. The western U.S. supplied 4.96 million m^3 of softwood chips to Japan in 1989 and 2.15 million m^3 of hardwood chips.

High hardwood chip prices in the Pacific Northwest prompted Japanese buyers to look for other sources. One promising region is the South. Shipments of southern hardwood chips to Europe and Asia jumped from 66 tons in 1987 to 173,000 tons in 1988. Much of the tonnage went to Japan.

However, in mid-1989, heavy rains curtailed logging in Texas, Louisiana, Mississippi, and Florida, and woodchip and roundwood inventories of hardwood and pine sank

PULPWOOD CONSUMPTION, EXPORTS, IMPORTS, AND PRODUCTION IN THE U.S., SPECIFIED YEARS 1952-86, WITH PROJECTIONS TO 2040

(million cords)

Year	Consumption	Exports	Imports	Production				
				Total production	Roundwood			Chips
					Total	Softwoods	Hardwoods	
1986	92.1	1.9	0.6	93.4	57.1	35.3	21.8	36.3
1976	75.3	3.3	1.1	77.4	47.6	33.0	14.7	29.8
1970	69.6	2.0	1.1	70.5	50.2	36.7	13.6	20.2
1962	44.1	0.1	1.4	42.8	33.3	24.3	9.0	9.4
1952	27.2	—*	2.1	25.0	23.5	20.0	3.5	1.6

PROJECTIONS

Year	Demand in U.S. mills	Exports	Imports	Demand				
				Total demand	Roundwood			Chips
					Total	Softwoods	Hardwoods	
2000	112.3	1.9	1.3	112.9	84.7	49.4	35.3	28.2
2010	130.0	1.7	1.2	130.5	101.8	56.4	45.4	28.7
2020	141.9	1.6	1.1	142.4	110.2	60.2	50.0	32.2
2030	152.1	1.5	1.0	152.6	118.6	63.9	54.7	34.0
2040	158.2	1.5	1.0	158.7	124.1	66.6	57.5	34.6

*Less than 50,000 cords.
Note: Data may not add to totals because of rounding.
Source: U.S. Dept. of Agriculture, Forest Service.

drastically. Several large sawmills in Texas had to shut down as log supplies dried up, and pulp mills subsequently had to use more pine. In Georgia, pulpwood logs rose from $38/cord f.o.b. in the second quarter to $42 to $45 by mid-year. However, rising log prices did not drive up chip tabs. These included residual hardwood chips at $16/ton f.o.b. sawmill and pine at about $20/ton. Spot prices for hardwood chips were in the $20/ton range. Second-quarter 1989 exports of hardwood chips from southeastern Atlantic/Gulf ports brought in $85 to $95/bdu f.o.b. vessel.

By the end of first-quarter 1990, prices in the south did not appear to be moving much from the $27/m^3 seen in fourth-quarter 1989 for softwood chips and $24/m^3 for hardwood, according to *Wood Resource Quarterly*.

Louisiana's fourth-quarter 1989 pulp chip prices averaged $20.65/green ton of pine and $16.47/green ton of hardwood f.o.b. sawmill. And at the start of the second quarter, pine prices were still at that level, though hardwood had dropped to $14 to $15/green ton. Hardwood inventories had been high but were expected to shrink because of rain, while pine inventories were lower. Domestic hardwood chips in the Southeast were selling for

TIMBER SALES FROM WESTERN WASHINGTON AND WESTERN OREGON

Year	Timber sold on publicly owned lands		National forest only	
	(billion bd ft)	($/000 bd ft)	Douglas fir ($/000 bd ft)	All species* ($/000 bd ft)
1989	2.8	$300	$390	$268
1988	5.0	200	256	206
1987	5.4	150	190	162
1986	6.2	108	161	128
1985	4.8	86	126	101
1984	5.0	90	133	95
1983	5.2	115	162	113
1982	5.6	93	118	80
1981	5.2	228	350	231
1980	5.7	291	432	432
Average	5.1	$166	$232	$182

*Covers Washington, Oregon, and northern California.
Source: U.S. Forest Service.

HISTORIC TRENDS IN U.S. PULPWOOD COSTS

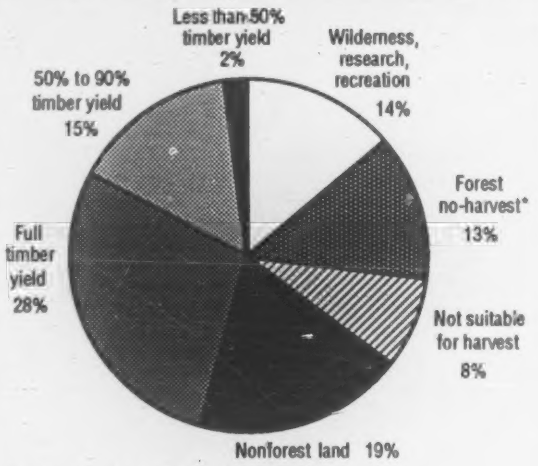
Second quarter	South				Wisconsin		West Coast
	Roundwood pine $/cord[1]	Roundwood hardwood $/cord[1]	Greenchip pine, clean $/ton[2]	Greenchip hardwood, clean $/ton[2]	Roundwood aspen $/cord[5]	Roundwood jack pine $/cord[3]	Douglas fir chip, export $/bdu[4]
1990	$47.98	$42.81	$21.28	$16.73	$42.00	n.a.	$117.00
1989	45.04	38.29	19.98	15.80	n.a.	n.a.	$118.00
1988	42.94	35.40	20.34	17.01	n.a.	n.a.	78.20
1987	42.43	34.10	23.73	18.76	$32.50	$47.75	77.40
1986	41.69	31.57	23.52	17.65	32.00	56.00	79.40
1985	48.97	33.00	25.83	18.32	34.00	58.00	85.80
1984	48.43	32.52	25.96	17.75	32.00	50.85	78.00
1983	45.73	32.01	25.19	17.27	33.00	49.25	79.62
1982	42.86	31.71	22.93	16.20	35.00	54.75	100.75
1981	40.67	30.38	21.45	15.34	34.00	50.25	101.50
1980	40.16	30.77	18.50	14.38	32.65	43.50	113.25
1979	36.71	27.99	15.52	12.73	29.88	41.80	53.00
1978	34.00	26.60	14.30	12.10	27.38	34.46	n.a.
1977	32.20	25.50	13.80	11.60	25.25	35.88	n.a.
1976	31.20	25.50	13.50	11.20	24.75	30.82	n.a.

n.a. = Not available.
1. Average for 11 southern states, delivery to dealer yard (*Timber Mart-South*).
2. Average for 11 southern states, delivery to pulp mill through 1987. F.o.b. sawmill from 1988 forward (*Timber Mart-South*).
3. Median prices, delivery to mill (*Wisconsin Forest Products Price Review*).
4. F.a.s. to Japan.
Source: *Pulp & Paper Pricebook*.

$16 to $18/ton f.o.b. sawmill in mid-1990.

Like the Pacific Northwest, the South has had environmental issues to reckon with, though southern mills are less dependent on federal timber than those in the Northwest. Concern for the endangered red cockaded woodpecker prompted the U.S. Forest Service to change harvest plans in forests in several southern states to prevent clear-cutting within three-quarters of a mile of woodpecker colonies. That was expected to reduce the national forest timber harvest in the region by 56 million bd ft in 1990 and 25 million bd ft/year thereafter.

NATIONAL FORESTLAND ALLOCATIONS IN WESTERN OREGON AND WASHINGTON



Total land = 24.7 million acres.
*Includes roadless and spotted owl habitat.
Source: U.S. Forest Service.

Rather than environmental issues, weather and natural disasters have been playing the dominant role in southern timber supply recently. The Commerce Dept. noted that the southern pine beetle continued to harm trees, especially in Georgia, Mississippi, North and South Carolina, and Texas. The infestation has been called the most damaging on record.

Along with the rains that hit the region in mid-1989, Hurricane Hugo smashed South Carolina last September. According to the South Carolina Forestry Commission, one-third of the state's forestland—or about 6.7 billion bd ft—was damaged by the hurricane. The storm took out 16 years' worth of hardwood consumption and felled more trees than could be collected before rot set in. Salvage pine logs were bringing in just $2 to $3/cord, but increased logging costs essentially brought prices to their normal level for the customer.

By third-quarter 1989, these troubles had pushed up hardwood chip prices in the Southeast at least $5 to $9/ton from second-quarter levels. The hurricane and greater demand for hardwood from new mills in the area may lead to shortages.

The rest of the country has not been immune to destruction due to natural causes, though it has suffered on a smaller scale. The Commerce Dept. noted that the gypsy moth, a particular problem in Pennsylvania, defoliated 2.9 million acres of hardwood in the East during 1989.

In the Northeast and Great Lakes region, most timberland is held by private landowners, who provide about three quarters of the timber harvested. Much of that is hardwood (supplied as roundwood) and growth outpaces demand.

In the Pacific Northwest, on the other hand, just over half the forestland is owned publicly, and much of the pulp and paper demand is supplied from residuals from wood products manufacturing

U.S. EXPORTS AND VALUE OF WOODCHIPS

	Quantity			Average value	
Year	Short tons	Metric tons	Value	$/short ton	$/metric ton
1989	4,357,811	3,954,456	388,154,000	$89.07	$98.16
1988	3,503,100	3,178,857	286,191,000	81.70	90.03
1987	2,546,467	2,310,769	188,459,018	74.01	81.58
1986	2,428,333	2,202,935	170,022,023	70.02	77.18
1985	2,317,989	2,102,833	168,813,781	72.83	80.28
1984	2,325,163	2,109,341	164,058,053	70.56	77.78
1983	2,554,176	2,317,097	171,269,000	67.05	73.92
1982	2,860,133	2,594,655	231,140,000	80.81	89.08
1981	3,846,049	3,489,059	314,037,000	81.65	90.00
1980	4,478,234	4,062,564	377,899,701	84.39	93.02
1979	4,498,674	4,081,107	197,846,642	43.98	48.48
1978	3,617,574	3,281,791	156,679,856	43.32	47.74
1977	4,037,901	3,663,103	178,223,078	44.14	48.65
1976	3,946,817	3,580,473	153,001,887	38.77	42.73
1975	3,177,204	2,882,296	115,384,797	36.32	40.03
1974	3,865,780	3,506,958	113,929,564	29.47	32.49
1973	3,480,840	3,157,748	85,727,159	24.63	27.15
1972	2,524,415	2,290,099	57,070,248	22.61	24.92
1971	1,978,731	1,795,065	41,123,878	20.69	22.91
1970	2,418,161	2,193,707	36,634,138	15.15	16.70

Source: Bureau of the Census.

U.S. PULPWOOD PRICES (CHIPS)

(US$/ton, f.o.b. sawmill; average for 11 southern states)

	Greenchips (clean)	
Year	Pine	Hardwood
1990		
2Q	$21.28	$16.73
1Q	21.63	16.83
1989		
4Q	21.02	16.66
3Q	20.55	16.03
2Q	19.98	15.80
1Q	20.16	15.70
1988		
4Q	20.51	16.62
3Q	20.56	16.50
2Q	20.34	17.01
1Q	20.84	16.98
1987		
4Q	20.12	17.02
3Q	18.76	14.05
2Q	23.73	18.76
1Q	23.60	18.52
Year end		
1986	22.50	17.61
1985	24.04	17.66
1984	26.18	18.03
1983	25.68	17.64
1982	23.83	16.52
1981	21.82	15.01
1980	19.30	14.72
1979	16.71	12.97

Note: Beginning in third-quarter 1987, all chip prices are quoted f.o.b. sawmill rather than f.o.b. consuming mill.
Source: *Timber Mart-South.*

U.S. PULPWOOD PRICES (ROUNDWOOD)

US$/cord, delivered to dealer yard;
average for 11 southern states)

Year	Pine	Hardwood
1990		
2Q	$47.98	$42.81
1Q	48.46	41.32
1989		
4Q	49.13	42.70
3Q	48.09	40.79
2Q	45.04	38.29
1Q	45.05	38.11
1988		
4Q	42.90	36.25
3Q	43.00	37.12
2Q	42.94	35.40
1Q	42.84	36.03
1987		
4Q	41.67	33.96
3Q	41.46	33.73
2Q	42.43	34.10
1Q	41.55	33.40
Year end		
1986	41.45	32.50
1985	45.17	31.89
1984	48.75	32.98
1983	47.72	32.43
1982	43.28	31.90
1981	40.99	30.60
1980	43.32	30.95
1979	37.95	30.00

Source: *Timber Mart-South.*

U.S PULPWOOD PRICES (PINE AND MIXED HARDWOOD)

(US$/cord, f.o.b. car; state average for Louisiana)

Year	Pine	Mixed hardwood
1990		
2Q	$59.31	$47.69
1Q	41.92	48.68
1989		
4Q	60.85	50.80
3Q	62.46	51.15
2Q	48.05	37.52
1Q	49.39	n.a.
1988		
4Q	54.20	$46.13
3Q	51.93	45.51
2Q	53.76	48.90
1Q	49.01	46.80
1987		
4Q	51.57	46.28
3Q	51.06	44.56
2Q	46.56	45.46
1Q	53.49	45.05
1986		
4Q	48.20	41.21
3Q	47.79	34.91
2Q	n.a.	n.a.
1Q	23.68	22.94
Year-end		
1985	41.00	35.31
1984	48.00	n.a.
1983	n.a.	n.a.
1982	47.08	35.68
1981	44.85	34.83
1980	39.75	31.96
1979	40.80	33.45
1978	35.65	28.65

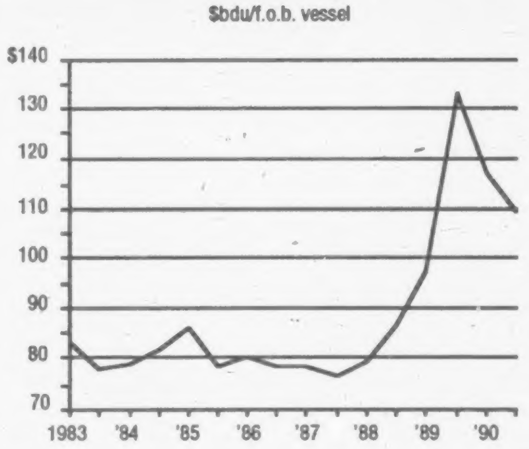
n.a. = Not available.
Source: *Louisiana Forest Products Quarterly Market Report.*

U.S. TIMBER HOLDINGS OWNED OR CONTROLLED BY MAJOR U.S. PAPER COMPANIES

Company	Acreage (000 acres)
Weyerhaeuser	19,017
Champion International	6,432
Boise Cascade	6,188
IP Timberlands	6,168
Georgia-Pacific	6,100
Great Northern Nekoosa	3,669
James River[1]	3,617
Scott Paper	2,800
Union Camp	1,694
Louisiana-Pacific	1,514

[1] 1988 figure.
Source: 1989 annual reports.

EXPORT PRICE OF DOUGLAS FIR CHIPS FROM PACIFIC NORTHWEST TO JAPAN



United States:

ENERGY USE AND CONSERVATION

The most dramatic recent event on the energy front was Iraq's mid-1990 invasion of Kuwait and its threatening stance toward its other neighbors, particularly Saudi Arabia. The aggression created a crisis atmosphere worldwide and caused oil prices to bounce around significantly—topping $28 per barrel in early August vs $20 just before the invasion. Unfortunately, the pulp, paper, and paperboard industry remains one of the largest users of oil among U.S. manufacturing industries. However, producers found themselves in a better position to ride out this disruption than they had been in the past.

In 1972, for instance—just before the OPEC oil embargo, the industry relied on purchased fuel and energy for 59% of its power supply. By 1989, pulp, paper, and board producers had scaled that fraction back to 42%, according to American Paper Institute figures. And the 30 million barrels of fuel oil consumed in 1989 accounted for less than 8% of the industry's energy supply, down from 22% in 1972, when more than twice the amount of oil was used. API also noted that natural gas consumption had dropped 17%, and total fossil fuel and purchased energy consumption was off by 15%. All told, self-generated and residue sources of energy provide the industry with the equivalent of 225 million barrels of oil—or about 26 days of oil imports—per year. (The main source of the self-generated fuel is spent pulping liquor, followed by hogged fuel and bark.) On top of that, pulp and paper manufacturers used just 26.7 million Btu/ton of production in 1989 vs 33.0 back in 1972 while hiking production by more than 50%.

Although less dependence on oil is positive news, Jeremy Metz, director of energy, materials, and technology at API, warned that a rise in the cost of one energy source is often mirrored in other sources. If that is not the case this time, the industry may consider turning even further away from fuel oil. A significant amount of the industry's boiler capacity can swing between oil and gas or coal. Nonrecyclable wastepaper is another alternative.

The industry's appetite for natural gas had been trailing off since 1981, but consumption bumped up again in 1989. Natural gas represents 15% of the industry's energy requirements, almost twice the Btus supplied by fuel oil. Use of coal, which supplies nearly as much of the industry's demand, has been dropping—in spite of its steadier pricing per Btu compared with the rise and fall in other fuels. Purchased electricity accounts for 6.4% of the power supply,

U.S. PULP AND PAPER INDUSTRY PURCHASED ENERGY COSTS AS PERCENTAGE OF SHIPMENTS

(billion $)

Year	Purchased energy costs*	Value of shipments	As percentage of shipments
1989p	4.19	57.70	7.3%
1988	4.00	57.18	7.0
1987	4.18	51.52	8.1
1986	4.25	43.99	9.7
1985	4.83	39.17	12.3
1984	5.05	41.38	12.2
1983	4.84	36.07	13.4
1982	4.71	34.00	13.9
1981	4.76	35.11	13.5
1980	4.03	31.76	12.7
1979	3.27	27.99	11.7
1978	2.70	24.03	11.3
1977	2.55	22.30	11.4
1976	2.19	20.98	10.5
1975	1.88	17.82	10.5
1974	1.65	18.53	8.9
1973	0.93	13.71	6.8
1972	0.81	11.70	6.9

*Includes electric energy, fuel oil, coal, natural gas, and other fossil fuels.
p = Preliminary.
Sources: American Paper Institute, Bureau of the Census.

somewhat less than fuel oil.

The industry is in the forefront of self-generation and cogeneration of electric power. API said cogeneration usually is achieved by producing steam at high pressure and temperature and using the steam first in electric power turbines and then in process applications. Inplant electric generation and cogeneration have grown by about half since 1982 alone, and power sold to utilities in 1989 was eight times what it was ten years earlier. A General Electric survey found that the industry added 337 MW of new power capacity in 1989 and will add 586 MW in 1990.

Nevertheless, purchased energy costs as a percentage of the value of pulp and paper industry shipments could be trending back up after a respite. That ratio rose from 6.9% in 1972 to a peak of 13.9% ten years later. The ratio then receded but has now turned up again, rising from a low of 7.0% in 1988 to 7.3% in 1989, API said.

Some regions of the U.S. would be hit harder by inflated oil prices than others. Oil provides 36% of the energy used by the pulp and paper industry in New England—far higher than the 8% average nationwide. And the region accounts for one third of the industry's oil consumption nationwide, with the South Atlantic region using another third.

Energy use differs considerably by grade. Newsprint made primarily from thermomechanical pulp uses a considerable amount of energy per ton produced, mainly provided by purchased electricity and fossil fuels. Unbleached kraft linerboard has a lower energy requirement per ton produced, and about half of the energy comes from burning black liquor. Recycled grades take up less total power per ton than virgin paper and board products. But recycled manufacturers rely on purchased fossil fuels and electricity, and some virgin grades—such as kraft linerboard—require less purchased energy than their recycled counterparts.

The U.S. pulp and paper industry is in the midst of the seventh consecutive year of record capital spending, though growth in spending has now slowed some. In 1990, paper manufacturers expected to shell out $17.2 billion on new plants and equipment, up just 10% over the previous year, according to Dept. of Commerce figures. Capital spending in 1988 was 25% higher than in 1987, followed by an increase of 40% the following year.

In *Pulp & Paper* magazine's January 1990 survey of spending plans, companies reported that they planned to put $18 billion into capital projects over 1989-91. Much of the increase will be aimed at pulp mill improvements and new paper machine installations. Outlays for power plants have dropped steadily from early in the 1980s as a fraction of total mill spending, as lower energy costs have allowed manufacturers to shift their attention to other parts of their mills. Over the period 1989-91, paper firms will spend $1.36 billion on energy-related production projects, a mere 0.5% increase over the plans for 1988-90 announced the previous year. Energy projects account for just 8.1% of pro-

U.S. PULP AND PAPER INDUSTRY ESTIMATED FUEL AND ENERGY USE

Source	1989 Consumption (trillion Btus)	% of total*	1988 Consumption (trillion Btus)	% of total*	1987 Consumption (trillion Btus)	% of total	1972 Consumption (trillion Btus)	% of total*
Purchased electricity	152	6.4%	155	6.5%	148	6.2%	93	4.4%
Purchased steam	18	0.8	21	0.9	17	0.7	23	1.1
Coal	327	13.8	330	13.9	335	13.9	225	10.7
Residual fuel oil	176	7.4	178	7.5	160	6.7	447	21.2
Distillate fuel oil	8	0.3	8	0.3	8	0.3	22	1.0
Liquid propane gas	3	0.1	3	0.1	3	0.1	3	0.1
Natural gas	348	14.7	332	14.0	345	14.3	443	21.0
Other purchased energy	3	0.1	2	0.1	25	1.0	2	0.1
Energy sold	(32)	—	(39)	—	(35)	—	(13)	—
Total purchased fossil fuel and energy	1,004	42.3	990	41.8	1,006	41.8	1,243	59.0
Hogged fuel, 50% moisture	246	10.4	263	11.1	258	10.7	42	2.0
Bark, 50% moisture	135	5.7	124	5.2	135	5.6	95	4.5
Spent liquor, solids	934	39.3	928	39.2	950	39.5	700	33.2
Self-generated hydroelectric	13	0.5	11	0.5	12	0.5	9	0.4
Other self-generated energy	11	0.5	11	0.5	10	0.4	3	0.1
Total self-generated and residue fuels	1,338	56.4	1,337	56.5	1,364	56.7	845	40.1
Total energy	2,342	—	2,328	—	2,371	—	2,093	—

Note: Columns may not add to total due to rounding.
*Total excludes energy sold.
Source: American Paper Institute.

duction-related spending, compared with 10% the prior year and 17% the year before that.

Just 15 new boilers are planned over 1989-91, while 25 were installed in 1987-89 and at least 40 during 1985-87. On the flip side of that equation, however, the number of recovery boilers approved recently shot up as mills planned for significant kraft pulp expansion.

GE notes that power and recovery boiler capacities have been rising in the pulp and paper industry and that alternative boiler designs, including gasifiers and fluidized bed boilers, are gaining attention. They can give added fuel flexibility and can cut down on waste treatment byproducts such as sludge.

For example, Manufacturing and Technology Conversion International Inc. of Santa Fe Springs, Calif., is developing a system that can gasify fiber residue (from recycled-paper production) as well as black liquor; the gas can then be burned in modified natural gas boilers or furnaces to produce hot water, steam, and heat. The U.S. Dept. of Energy, Weyerhaeuser Co., and the California Energy Commission—the agency that set up the contract for the project—are among donors who will supply a total of $3.3 million in funding for the enterprise.

The commission believes the new technology will be safer than conventional boilers, which it says have a one-in-five chance of exploding in 20 years of operation. And it notes that using waste fiber for energy production could be a lot cheaper than burying it in a landfill.

ENERGY USE PER TON OF PULP, PAPER, AND BOARD PRODUCED

	1989p	1988	1987	1972
Energy consumption (trillion Btus)	2,203.6	2,167.6	2,371.0	1,756.2
Total paper and board production (million tons)	82.4	80.5	74.3	53.3
Energy use/ton (million Btus)	26.7	26.9	31.9	33.0

p = Preliminary.
Source: American Paper Institute.

United States:

TRANSPORTATION

Transportation in the U.S. has changed throughout the decade because of deregulation, although services for the pulp and paper industry have not shifted drastically in the last couple of years. Pulp and paper shipments essentially remain divided at about 60% rail and 40% truck. Competition among rail lines and between rail and trucking continues to increase, with rail losing some business to trucking. Rail tends to have the advantage on long-haul cargoes, whereas trucking is often better suited for short-haul deliveries and lightweight products such as sanitary tissue.

Aggressive transportation environment. In 1980, the U.S. adopted Staggers Rail Act, which substantially deregulated the rail industry and ultimately stabilized freight rates at reasonable levels. Government statistics indicate that prices posted their biggest gains in the years immediately preceding and following implementation of the act. Indeed, rates for pulp and paper products increased a hefty 20.5% from 1979 to 1980. However, rate increases began to settle down by 1983. The biggest jumps in recent years occurred in 1984 and 1988, when rates increased 4.5% and 4.0%, respectively. Selected rate increases on paper and chemicals were implemented at the beginning of 1989. Freight prices increased only 0.3% from 1988 to 1989. "Competition due to deregulation has made it almost impossible to raise rates," said Tom White, of the Assn. of American Railroads (AAR). "A lot of traffic now moves under contract, which provides a way of maximizing the use of equipment, and increase of utilization (more loaded moves) can be translated into cost reduction."

CARLOADINGS OF MAJOR U.S. RAILROADS

(000 cars loaded)

Year	Pulp, paper, and allied products	Primary forest products	Lumber and wood products	Total forest products	All railcar loadings
1989	540	472	339	1,351	17,621
1988	638	512	391	1,541	22,140
1987	647	544	419	1,610	20,812
1986	655	532	397	1,584	19,477
1985	712	584	366	1,662	19,574
1984	763	697	372	1,832	20,257
1983	778	739	368	1,885	18,800
1982	829	766	308	1,903	18,498
1981	966	939	397	2,332	21,618
1980	1,060	1,002	469	2,531	22,598
1979	1,097	1,055	597	2,749	23,876
1978	1,094	1,086	649	2,829	23,373
1977	1,103	1,112	675	2,890	23,173
1976	1,101	1,139	670	2,910	23,457

Source: Assn. of American Railroads.

The real (constant dollar) price of railroad transportation on a ton-mile basis has been reduced for all freight and declined 1.9% in 1989 to $2.67/ton-mile, according to AAR. The Staggers Rail Act encourages rail carriers to show more sensitivity to the needs of shippers. While enjoying increased financial stability, carriers have also posted significant gains in efficiency and productivity, which are then passed on to shippers because of the competitive marketplace.

The rail industry has nevertheless continued to lose ground in the paper industry. Carloadings of pulp and paper products in the U.S. posted a dramatic fall of 18.2% in 1989 to 540,000 cars, with a high overall freight drop of 25.7%. The 1989 decline follows a slight drop of 1.4% in 1988 to 638,000 cars, down from 647,000 cars in 1987, according to AAR. The 1989 figure is 41.3% lower than it was in 1984. The pulp, paper, and paperboard industry is, in fact, the primary user of boxcar rail transportation, according to documents filed by the American Paper Institute with the Interstate Commerce Commission (ICC) in support of a boxcar pooling arrangement.

Carriers have targeted the pulp and paper industry for new services. For example, Consolidated Rail Corp. (Conrail) in 1989 introduced a service geared toward rolled paper producers making newsprint, pulpboard, groundwood paper, kraft paper, and printing paper. The service, called Paper Connection, allows buyers without rail sidings to take advantage of long-haul rail combined with just-in-time truck delivery.

Conrail has contracts with six independent distribution centers that are within 90-min driving time of most paper users within their markets. The distribution centers, each with rail-truck transfer and storage facilities, are located in Elizabeth and New Brunswick, N.J.; The Bronx and Syracuse, N.Y.; Harrisburg, Pa.; and Cincinnati, Ohio. Each center uses computerized inventory control management systems.

Conrail said the service can eliminate the expense of long-distance trucking for less-than-truckload shipments. Under the program, the line moves boxcar shipments from mills to the distribution centers, then ships directly by truck or stores the cargo for just-in-time shipments.

Another service developed for the paper industry is CSX Transportations' Total Distribution Services Inc. The service moves paper in boxcars to one of 28 warehouses located across the southern, midwestern, and northeastern U.S. CSX maintains the inventory and oversees distribution and truck delivery on a just-in-time basis.

A plan targeted at pulp and paper shippers that has not moved very far is boxcar pooling, which was designed to make boxcars more readily available for shipping pulp and paper. It was approved by ICC in 1987. Pooling was supported by API and several large paper companies, along with major rail lines including Conrail, CSX, and Southern Pacific Transportation Co.

Boxcar pooling allows a central management company to coordinate use of boxcars from various railroads that might otherwise be empty on return trips. Supposedly, most of these cars are specially designed for shipping pulp and paper or similar products. Because of past inefficiencies in the system, paper companies have reduced their use of the aging boxcars by more than half, relying instead on truck, truck-trailer piggyback on rail, and intermodal container rail shipping. Double-stacking container is particularly advantageous to shippers on transcontinental routes.

Piggyback traffic, also known as intermodal, trailer-on-flatcar, or container-on-flatcar, has grown in popularity. It accounts for more than 25% of all rail carloadings. Piggyback traffic rose 40% during 1981-85, 10% in 1986, and another 7% to 8% in 1987, according to the Dept. of Commerce. Overall, piggyback traffic is the fastest growing segment of the industry, with close to 6 million containers being loaded in 1989, a 2.9% increase over 1988. Figures for the first six months of 1990 showed a 3.5% increase over the same period in 1989. "Intermodal transportation is a great way to combine the long-haul cost-efficiency of railroads with the short-haul flexibility of trucks," said White. "We're at our best moving long distances; they're better at moving shorter distances."

Rail has also lost ground to waterborne shipping in certain special cases. Scott Paper Co. decided for 1990 to have both woodchips and roundwood shipped to its Mobile, Ala., mill by river barge rather than rail.

Competition strong in trucking. The U.S. trucking industry was essentially deregulated in 1985, and it has been under severe competitive pressures ever since. This level of competition has kept freight prices down while costs, such as insurance and taxes, have escalated.

Developments in 1990 in the Persian Gulf have had a strong effect on the trucking industry due to increases in fuel prices. "There has been a 45% increase in the cost of diesel fuel since the end of July," said David Gordon, of the American Trucking Assn. (ATA). "The proposed gasoline tax on top of this already inflated price would certainly impact the trucking industry."

One paper industry official said that two other key issues affecting trucking are a shortage of qualified drivers and the ease of entry for startup companies, which then undercut established firms.

Trucking has also been fighting its image as a road menace. In 1986, truckers supported passage of the Motor Carrier Safety Act. MCSA set up guidelines that prohibited drivers from holding more than one license after July 1987, set federal standards for testing and licensing truck drivers by July 1988, established a national clearinghouse for exchange of driver information by July 1989, required states to be in full compliance by September 1993 or lose

U.S. RAILROAD FREIGHT PRICE INDEX

(1984 = 100)

Year	Pulp, paper, and allied	% change from previous year
1989	105.1	0.3%
1988	104.8	4.0
1987	100.6	-0.4
1986	101.0	1.0
1985	100.0	0.1
1984	99.9	4.5
1983	95.6	1.0
1982	94.7	10.8
1981	85.5	11.5
1980	76.7	11.6
1979	68.7	20.5
1978	57.0	5.7
1977	53.9	5.7
1976	51.0	8.3
1975	47.1	13.5
1974	41.5	15.3
1973	36.0	0.3
1972	35.9	1.4
1970	35.4	12.4
1970	31.5	9.0
1969	28.9	n.a.

n.a. = Not available.
Source: Bureau of Labor Statistics.

federal highway money, toughened penalties for drug and alcohol abuse on the road, and increased federal funding for more roadside inspections from $16 million to $60 million in 1991.

Ocean transportation drags anchor. Oceangoing carriers have had their own problems under deregulation. For example, by April 1989, freight rates for shipping woodpulp and kraft linerboard from the East Coast to continental Europe fell 28% and 2%, respectively, from their levels at the beginning of 1984. In addition, rates between Longview, Wash., and Japan for milk carton stock fell almost 27% during the same period. U.S. West Coast-Far East trade had been in relative balance, but in late 1989, Pacific Commerce Line, a subsidiary of FedNav Ltd., Montreal, Que., introduced three new vessels to carry forest products on those routes. This was expected to have a disruptive effect on trade.

The situation has been further complicated by sharp increases in marine fuel costs. Robert Gottshall at the Transpacific Westbound Rate Agreement pointed out that the cost of marine fuel in summer 1989 was $67/ton. In June 1990, that figure had risen to $85/ton, and a few weeks later, following the Iraqi invasion of Kuwait, the price had jumped to as much as $152/ton.

Early in 1989, Weyerhaeuser Co. considered selling its Westwood Shipping Line as part of an effort to unload certain businesses but instead discontinued its transatlantic service in July 1989. The company is positioning itself to strengthen service to Pacific Rim markets, according to Weyerhaeuser president, Herb Winward.

Ocean transport represents about one-third of all U.S. waterborne shipping. It figures prominently in U.S. wastepaper exports, but overall shipments of pulp and paper have declined.

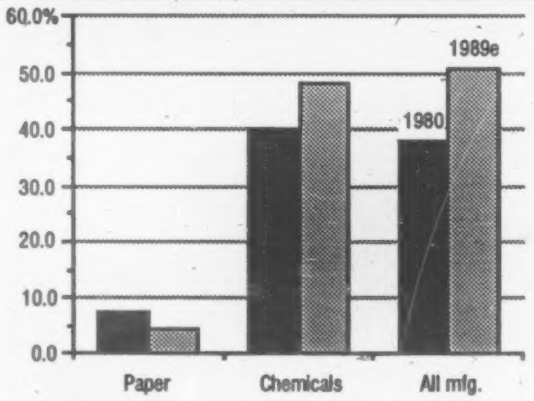
United States:

RESEARCH AND DEVELOPMENT SPENDING

In addition to the work done by paper companies, a significant amount of research into papermaking processes and technologies is performed by supplier companies, universities, and government agencies. Suppliers who perform a substantial amount of research work for the industry include manufacturers of papermaking equipment, felts and fabrics, computer control systems, and chemicals. Academic and government groups are particularly active in paper chemistry and forestry.

Leading research institutes specializing in paper science include the Institute of Paper Science & Technology (IPST) in Atlanta, Ga.; the U.S. Forest Products Laboratory in Madison, Wis.; and the Pulp & Paper Research Institute of Canada (Paprican) in Pointe Claire, Que.

R&D SPENDING PATTERNS, AS PERCENTAGE OF CAPITAL SPENDING



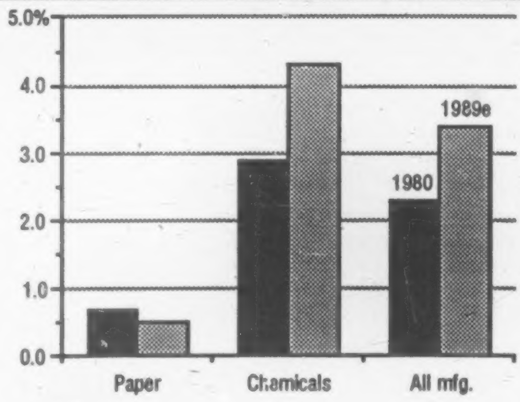
e = Estimate.

Source: Data Resources Inc.

Typical subjects on the research agenda include forest genetics and reforestation techniques, whole tree utilization, hardwood pulping processes, water- and air-quality analysis and control, improved energy use and recovery technology, new types of wet and dry forming of paper, computer process control, use of chemicals and fuel from byproducts and waste, and coating and packaging technology.

At the end of 1989, IPST moved from Appleton, Wis., (where it had been located for over 50 years) to a new facility on the campus of Georgia Institute of Technology. IPST said the main reason for the move was the intellectual stimulation that comes with proximity to a major research facility. Georgia Tech already has a chemical engineering program with a pulp and paper option, which will be

R&D SPENDING PATTERNS, AS PERCENTAGE OF SALES



e = Estimate.

Source: Data Resources Inc.

enhanced by the presence of IPST.

Mergers within the paper industry have caused the number of IPST's dues payers to decrease. In the last couple of years, however, the percentage of pulp and paper production accounted for by its membership relative to total U.S. production has increased. City officials are now touting their own Atlanta as the U.S. headquarters for paper industry research and development (R&D), given the fact that the Technical Assn. of the Pulp & Paper Industry is also located in Atlanta.

In order to fill the vacuum created by IPST's departure from Wisconsin, the nation's only federal Forest Products Laboratory, located at the Univ. of Wisconsin at Madison, has been inviting paper companies to tour the lab and explore the potential for joint research projects. The lab has a complete research-scale paper mill, and it is currently working on four areas of research with numerous ongoing projects, including research agreements with paper companies. The Biopulping Consortium, the largest current project, is a group of 16 paper companies put together to conduct biopulping research. Such cooperative research projects were made feasible in 1986 with passage of the Technology Transfer Act, which allows federal facilities to work confidentially with companies, delaying public release of information for three to five years in most cases. The lab has a $14.4-million budget, but only $4.1 million goes to pulp and paper research.

Another method of funding R&D is joint projects between supplier companies and research institutions. For example, Beloit Canada Ltd., Beloit Corp. of the U.S., and Paprican are working to develop a commercial high-temperature pressing system that will employ the principles of impulse drying. The project will initially focus on newsprint and other uncoated groundwood papers of less than 85 g/m².

Separately, Paprican is devoting considerable research to determine how to use more chemi-thermomechanical pulp in printing papers, tissue, and packaging grades. It is also looking into the best uses for Canada's abundant hardwood stands. In chemical pulping, Paprican said its major objective is to learn how to retain pulp strength normally lost when cooked chips are discharged from kraft digesters. The Institute is also spending much time researching the elimination of dioxins and decreasing the formation of organochlorides in chemical bleach plants.

At this point in the paper industry's development, a large portion of expenditures on R&D is lumped together under the rubric of spending on environmental and consumer protection. The U.S. paper industry's National Council of the Paper Industry for Air & Stream Improvement has spent a lot of money researching how trace amounts of dioxin are formed as an unwanted byproduct of bleached kraft pulp processes. It is also paying for risk assessments in order to prove to consumers that using bleached paper products is safe.

Industry expenditures. R&D spending for the paper and allied industries totaled $611 million in 1987—a 13.6% increase over 1986 and the largest percentage increase of the major industries shown in the accompanying table, according to the National Science Foundation (NSF). (NSF has not published an update on R&D spending since 1987.)

According to Data Resources Inc.'s July 1989 survey of R&D expenditures, the latest available, the paper industry lags in its ratio of R&D spending to total capital expenditures. R&D outlays came to 6.0% of capital spending in 1988, compared with 55.4% for all manufacturing. As a percentage of paper industry sales, R&D accounted for 0.5% in 1988 and 1989. This compares with a 3.5% level in 1988 and a projected 3.4% level in 1989 for all manufacturers. (DRI has discontinued publication of this survey, so information for 1990 is not available)

In dollar terms, DRI estimated that the paper industry spent $676 million on R&D in 1988. Spending in 1989 was projected at $721, rising to $726 million in 1991.

Year-to-year increases in the paper industry compare well with other groups, however. The paper industry raised R&D outlays an average of 10.7%/year between 1977 and 1986, compared with 11.5%/year for chemicals and 11.8%/year for all manufacturing.

DRI commented that industry in general is still more concerned with short-term profits than long-term opportunities. This trend is exacerbated by the fact that the tax credit for R&D was reduced from 25% to 20% in 1989 and that its renewal by Congress is uncertain. As the paper industry enters into a period of lower profitability, it seems unlikely that 1990 will see more funds being allocated to R&D.

The Battelle forecast estimates that the U.S. paper industry will spend $684 million on R&D in 1990, virtually all of which will come from the industry itself rather than from

R&D SPENDING BY INDIVIDUAL PAPER COMPANIES

	1989 R&D spending (million $)	% change 1989-88	1988 R&D expenditures (as % of sales)	(per employee)
Kimberly-Clark	$118.0	6.0	2.1	2,975.0
Weyerhaeuser	64.8	13.0	0.6	1,432.1
Scott Paper	63.7	-2.0	1.3	2,166.7
James River	56.5	24.0	1.0	1,345.2
Union Camp	47.6	8.0	1.7	2,552.8
Mead	34.9	-35.0	0.8	1,600.9
Westvaco	31.2	7.0	1.4	2,082.6
Boise Cascade	11.1	17.0%	0.3%	$570.3
Consolidated Papers	4.5	6.0	0.5	986.2
Industry composite	432.3	3.0	1.0	1,833.2

Source: *Business Week.*

government or nonprofit groups. This compares with a federal funding level of about 31% for R&D in all manufacturing industries. For example, the federal government funds about 10% of R&D in the fabricated metals industry and 38% in electrical machinery and communications.

Battelle forecasts that growth in R&D spending for U.S. industry as a whole will slow to 2.6%/year during the next few years, compared with an average of 3.6%/year from 1977 to 1987. Total R&D spending in the U.S. is forecast to reach $138.7 billion in 1990, a rise of 4.8% from the $132.4 billion that NSF estimates was spent in 1989. Battelle said that R&D spending is greatly affected by industrial restructuring, a renewed emphasis on short-term profits, and the weakness of the dollar, and it is less affected by uncertainties in the stock market and tax laws.

Released in mid-1989 by the federal Office of Technology Assessment (OTA), a study of ten manufacturing corporations involved in recent mergers or acquisitions found that high debt leads to reductions in R&D, although it was not the only factor causing a drop-off in corporate R&D spending. The OTA study's conclusions were confirmed by NSF, which focused on mergers and restructuring involving the largest R&D companies and found a 5.3% reduction in R&D spending in current dollars between 1986 and 1987.

Gearing up for 1992. In the opinion of many industry leaders, U.S. pulp and paper companies are not spending enough on R&D to enable them to compete successfully against other industries or against European and Scandinavian manufacturers in their own arena. This shortcoming will become critical as 1992 approaches, when the European Community becomes the world's largest single market. U.S. tissue producers are successfully competing in Europe. In contrast, North American producers of printing/writing papers are finding that their domestic market as well as the European market are being encroached upon by producers from Nordic countries.

U.S. PAPER INDUSTRY R&D SPENDING vs OTHER MAJOR INDUSTRIES

(million $)

Industry	1983	1984	1985	1986	1987	% change 1987/86
Nonferrous metals	$302	$319	$385	$418	$442	5.7%
Stone, clay, and glass	586	705	825	942	1,014	7.6
Chemicals	6,792	7,736	8,310	8,656	9,638	11.3
Paper and pulp[1]	552	594	576	538	611	13.6
Petroleum	2,074	2,245	2,194	1,971	1,885	-4.4
Food and beverage[2]	881	1,234	1,315	1,535	1,400	-8.8
Textile mill products/apparel	150	182	218	246	227	-7.7

1. 1985 data include allied products.
2. Data from 1984 onward include tobacco.
Note: All data were revised in 1987.
Source: Div. of Science Resources Study, National Science Foundation.

United States:

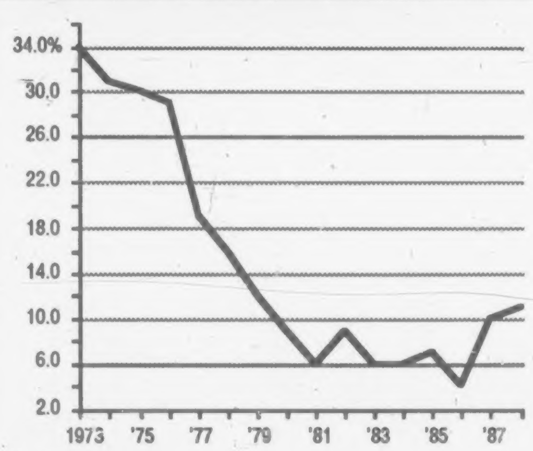
ENVIRONMENTAL SPENDING AND REGULATIONS

Pulp and paper manufacturers often find themselves in hot water on environmental issues on several counts. As Ely Gonick, senior vice president of International Paper Co. put it, the industry "cuts down trees, uses herbicides and insecticides, and disposes of byproducts in streams and landfills. And paper is the largest component of waste in municipal dumps." The industry has made great strides in improving these practices, but the cost has been great. The latest survey available from the National Council of the Paper Industry for Air and Stream Improvement (NCASI) estimated that the pulp and paper industry would spend $1.02 billion on environmental protection in 1989—a significant jump over the $572 million spent the previous year. Expenditures in 1990 and 1991 were expected to back off to about $700 million.

Although spending on air quality protection took about two thirds of the environmental budget in 1988, spending plans in 1989 dropped that fraction to less than half. Funds devoted to solid waste management tripled, while their share of the budget nearly doubled.

NCASI attributes the recent spending increases on environmental protection in part to pulp mill expansions

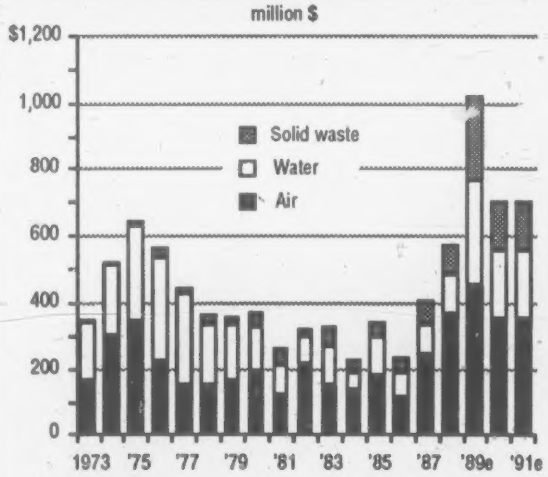
CAPITAL SPENDING FOR POLLUTION ABATEMENT, AS PERCENTAGE OF TOTAL SPENDING



e = Estimate

Source: National Council of the Paper Industry for Air and Stream Improvement.

CAPITAL SPENDING FOR POLLUTION ABATEMENT, BREAKDOWN BY AREA



e = Estimate.

Source: National Council of the Paper Industry for Air and Stream Improvement.

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necessitating new air pollution control equipment for kraft recovery furnaces, lime kilns, power boilers, and bleach plants, as well as wastewater and sludge treatment upgrades. New or modified kraft recovery furnaces, recausticizing systems, and noncondensible gas handling systems were needed to meet state limits on total reduced sulfur (TRS). And major expenses have arisen in the battle against dioxin, which is produced when chlorine is used to bleach pulp.

The term dioxin refers to 75 chlorinated compounds; the worst one is 2,3,7,8-tetrachlorodibenzo-*p*-dioxin, known as 2,3,7,8-TCDD. Although it has not been proven to be a human carcinogen, it is extremely toxic to lab animals in low doses. In 1988, the Environmental Protection Agency and the American Paper Institute conducted a study of the 104 U.S. bleached kraft pulp mills that use chlorine or its derivatives to bleach chemical woodpulp, looking for traces of dioxin in effluent, sludge, and pulp. Although the mills involved tried to suppress release of the test results, saying it would breach their confidentiality, EPA made the data public. The study turned up a median amount of dioxin in pulp of 6 ppt (parts per trillion) for softwood and 3.5 ppt for hardwood. Sludge showed a value of 17 ppt, and effluent levels were down around 24 ppq (parts per quadrillion).

The National Institute of Occupational Safety & Health took up its own study of dioxin, focusing on the impact of dioxin exposure on mill workers. And the Food & Drug Administration took a look at milk samples before and after packaging in solid bleached sulfate cartons. FDA indicated in 1989 that dioxin was migrating from bleached milk cartons into milk at levels below 0.1 ppt.

Producers have gradually gained ground against dioxin. API president Red Cavaney said that by mid-1990 the industry had already brought down dioxin contamination by nearly 50% in less than two years. "We're not filtering it out once it has been created," he added. "We're reducing its creation." And in the finished products category, manufacturers—who had committed to dioxin levels of 2 ppt in milk carton stock by the end of 1990—achieved those levels one year early. The industry is aiming for the same level by the end of 1992 in bleached paper and paperboard products that come into contact with food.

Also in mid-1990, EPA announced that dioxin levels in finished paper products had been cut to the point where they were just about safe, though there was still a ways to go in reducing dioxin in production waste to acceptable levels. EPA, pushed by a consent decree involving the Environmental Defense Fund and the National Wildlife Federation, then began developing regulations to reduce dioxin levels in waterways and soil. And it asked FDA to take responsibility for further lowering the "already low risks" tied to the presence of dioxin in food packaging.

While downplaying the potential harm from finished paper products, EPA perceived the consumption of fish downstream from pulp mills as a very real hazard and said it planned to "greatly lower dioxin discharges into those waters." In September 1990, EPA named 19 pulp and paper mills that had been releasing enough dioxin in their effluent to create a significant cancer risk for people who ate fish downstream of the mills. EPA also rated the risk from the rest of the 104 pulp and paper mills that make use of chlorine bleaching. Deputy EPA Administrator Henry Habicht said his agency "suggests that states consider imposing fish consumption advisories or start site-specific monitoring programs at all streams that have a projected risk as high as one in 10,000 or greater." The top 19 mills fell into that category.

EPA's cancer-risk list sparked protest from some of the companies named. International Paper, for example, which topped the list with a cancer incidence risk of two in 100 for its Georgetown, S.C., mill and had three other facilities in the top 19, said EPA's data was "outdated and misleading." Richard Phillips, IP's staff vice president and process technology director, stated that "EPA's conclusions were based on fish samples gathered several years ago, before improved manufacturing processes dramatically reduced the level of dioxin in paper mill outflow." He added that the Georgetown mill had cut dioxin formation 95% to date.

EPA and various states are in the midst of issuing wastewater discharge permits—known as National Pollutant Discharge Elimination System (NPDES) permits—to limit dioxin discharges from pulp and paper mills that use chlorine bleaching. Most of these permits for 66 of the worst-case mills will be issued by February 1991. By June 1993, the permits will call for the mills to meet water-quality-based effluent requirements developed by the states. Permits at other facilities will be issued as existing permits expire.

EPA has suggested a limit on dioxin in streams of 0.013

U.S. PAPER INDUSTRY ENVIRONMENTAL PROTECTION SPENDING

(million $)

Year	Water	Air	Solid waste	Total	% of total capital spending
1989pl	316	449	257	1,022	—
1988	129	360	83	572	11.0%
1987	93	242	68	403	10.0
1986	80	109	48	237	4.0
1985	121	175	46	342	7.0
1984	62	130	34	226	6.0
1983	118	149	60	327	6.0
1982	81	214	23	318	9.0
1981	91	120	49	260	6.0
1980	140	190	38	368	9.0
1979	178	158	23	359	12.0
1978	182	149	32	363	16.0
1977	278	148	17	443	19.0
1976	319	216	29	564	29.0
1975	286	341	18	645	30.0
1974	216	296	11	523	31.0
1973	179	162	10	351	34.0

pl = Planned.
Source: National Council of the Paper Industry for Air and Stream Improvement.

ppq, even though technology is not yet available to detect such low residues. The agency believes such a level would induce no more than one extra case of cancer or other severe illness among 1 million people drinking the water or eating fish from the water. However, individual states are still free to set their own dioxin guidelines, subject to EPA approval. The jockeying between the states and EPA over reasonable standards can get messy. Georgia originally planned to go with EPA's recommended 0.013-ppq level. But when kraft pulp producers kicked up a fuss, the state's Dept. of Natural Resources Board reviewed EPA's position as well as outside information and eventually settled on a standard of 7.2 ppq. EPA's Region IV officials then refused to approve the 7.2-ppq limit. Virginia also was relatively lenient and proposed a limit on dioxin contamination in receiving streams of 1.2 ppq.

In the meantime, EPA is developing national industrial effluent limit guidelines and standards based on best-available, economically achievable technologies to reduce dioxin contamination and total chlorinated organics from the manufacture of bleached paper products. Those standards will be proposed in 1993 and finalized in 1995 and will entail process changes to prevent the formation of dioxin. By 1995, mills will have to comply with whichever of the two types of standards (i.e. water-quality or technology-based) is more stringent. Finally, standards for the disposal of dioxin-con-taminated wastewater treatment sludge—particularly its use as a soil conditioner—will be set with the aid of the Resource Conservation and Recovery Act and the Toxic Substances Control Act.

API said one industry CEO pegged the cost for all these dioxin reductions at $2 billion. That is a hefty price tag, given that the pulp bleaching industry produces only 21 ounces of dioxin each year, or about 1.5% of the total U.S. release of dioxin to the environment from natural and man-made sources, according to API. By comparison, principal sources include municipal waste incinerators, secondary copper smelters, and coal combustion. EPA data from 1986 reported dioxin releases from those sources at about 50 lb/year for the incinerators and nearly 10 lb/year from the smelters and coal combustion. Cavaney does not believe those figures have changed substantially since then.

While EPA and API are basically in agreement over the gradual continued reduction of dioxin contamination in waste and paper products, others do not think enough is being done. The day EPA made its announcement, two Greenpeace members scaled Georgia-Pacific Corp.'s headquarters building in Atlanta, Ga., and displayed a banner saying, "Take the poison out of pulp," protesting the use of chlorine in G-P's paper products. Greenpeace is calling for the elimination of dioxin from pulp and paper production.

The Chlorine Institute considers EPA's interest in weaning the industry from chlorine as misguided. "We believe that any EPA pollution-prevention initiative should focus strictly on achieving pollution reduction that is necessary to protect human health and the environment and should not be aimed at mandating which bleaching chemicals or processes are or are not acceptable," said president Robert G. Smerko.

Nevertheless, producers managed to chase a fair amount

ENVIRONMENTAL LEGISLATION AFFECTING THE PULP AND PAPER INDUSTRY SINCE 1970

1970
Air Quality Standards Act
(Clean Air Act)
(P.L. 91-604)
Water Quality Improvement Act
(P.L. 91-224)
Resource Recovery Act
(P.L. 91-512)
Occupational Safety & Health Act
(P.L. 91-596)

1972
Water Pollution Control Act Amendments
(P.L. 92-500)
Environmental Pesticide Control Act
(P.L. 92-516)

1973
Clean Air Act Amendments
(P.L. 93-15)

1974
Safe Drinking Water Act
(P.L. 93-523)
Clean Air Act Amendments
(P.L. 93-319)

1976
Toxic Substances Control Act
(P.L. 94-469)
Resource Conservation & Recovery Act
(P.L. 94-580)

1977
Clean Air Act Amendments
(P.L. 95-95)
Clean Water Act Amendments
(P.L. 95-217)

1978
Resource Conservation & Recovery
Act Amendments
(P.L. 95-509)

1980
Solid Waste Disposal Act
(P.L. 96-482)
Comprehensive Response, Compensation &
Liability Act (Superfund)
(P.L. 96-510)

1986
Superfund Law
Safe Drinking Water Act Amendments

1987
Clean Water Act Amendments

1989-90
Clean Air Act Amendments

of dioxin out of their products and waste by replacing chlorine with chlorine dioxide in bleaching. They have also made use of more complete lignin removal to cut down the amount of bleaching required, used oxygen and hydrogen peroxide as additional non-chlorine-based delignification and bleach chemicals, and eliminated hypochlorite in the bleach operation.

The rush to cut discharges of chlorinated organics brought about an 18-month backlog of orders for chlorine dioxide generators by early 1990. But if a mill already had some chlorine dioxide capacity available, it could avoid waiting to expand chlorine dioxide production and setting up a multistep chlorination (C) stage. Instead, a producer could "spread some of the work of delignification and bleaching from the C and D (chlorine dioxide) stages into hydrogen-peroxide-enhanced extraction stages," according to John Webster, a senior technical service consultant with Du Pont Co. This would cut chlorine use. And some of the chlorine dioxide used in the existing D stage(s) could be shifted to the C stage for higher substitution because the hydrogen peroxide added during the extraction stage(s) could be used to do some of the bleaching work of the D stage. Webster said mills using this technique cut dioxin in pulp and filtrates as much as 90%, absorbable organic halide (AOX) levels dropped up to 30%, and chloroform by 60%.

Bleached kraft pulp mills may now be getting to the point where chlorine can be avoided altogether. Michigan Pulp & Paper Corp. wants to build a 1,200-tpd market pulp mill by Lake Huron in Michigan that would be non-sulfur-based and would use oxygen delignification and peroxide bleaching. The hardwood and softwood pulp would have a brightness of 84 to 88. Pulping would be done in two stages, using caustic soda with anthroquinone as a catalyst and oxygen. Bleaching would require hydrogen peroxide and caustic extraction using oxygen. Construction could begin in 1991 and be complete in 1993 or 1994.

Solid waste, like toxic discharges, is coming under greater scrutiny as consumers, regulators, and manufacturers become increasingly "green." Solid wastes from U.S. pulp and paper mills exceed 12 million tpy, most being dewatered primary and biological sludges that traditionally have been landfilled. As landfilling regulations have tight-

ENVIRONMENTAL EQUIPMENT USED IN THE NORTH AMERICAN PAPER INDUSTRY

Item	Installed cost each (000 $)	Units	Installed value (000 $)	Average item life (years)	Annual replacement (units)	Annual replacement cost (000 $)
Aerators and aeration equipment	$361	10,000	$3,610,000	14	714	$257,754
Air-handling equipment	210	47,000	9,870,000	15	3,133	657,930
Air and water monitoring equipment	35	11,500	402,500	12	958	33,530
Bark boilers	17,660	1,200	21,192,000	24	50	883,000
Black liquor oxidation equipment	2,460	1,000	2,460,000	18	56	137,760
Chemical metering equipment	18	26,000	460,980	10	2,600	46,098
Chimneys and ducts	505	12,000	6,060,000	21	571	288,355
Clarifiers	1,625	2,200	3,575,000	23	96	156,000
Cooling towers	992	1,800	1,785,600	14	128	126,976
Conveying equipment for bark and sludge	709	2,900	2,056,100	17	171	121,239
Diffusers	340	700	238,000	20	35	11,900
Dust and ash handling equipment	2,365	3,300	7,804,500	18	183	432,795
Economizers	1,280	3,500	4,480,000	19	184	235,520
Electrostatic precipitators	7,500	2,100	15,750,000	17	123	922,500
Filtration equipment	325	4,600	1,495,000	20	230	74,750
Filter media	17	4,000	67,000	14	286	4,791
Gas scrubbers	1,215	3,300	4,009,500	16	206	250,290
Heat exchangers	1,015	15,000	15,225,000	15	1,000	1,015,000
Pumps (sludge, etc.)	35	43,500	1,522,500	12	3,625	126,875
Recovery boilers	32,850	1,500	49,275,000	22	68	2,233,800
Screening equipment and savealls	265	7,600	2,014,000	18	422	111,830
Sludge thickening equipment	325	1,450	471,250	16	91	29,575
Water treatment equipment (influent)	1,620	1,500	2,430,000	25	60	97,200
Total			$156,253,930			$8,255,468

Source: Based on 1989-90 cost data provided by BE&K Engineering Co., projected industry-wide according to data acquired in previous *Pulp & Paper* surveys of U.S. and Canadian mills.

ened, incineration has become more popular, though the disposal problem is then transferred to resultant ash.

EPA has been working on nonhazardous waste landfill regulations, and many states are waiting to see what comes out before finalizing their own guidelines. The states have required that landfills be permitted only when there would be no adverse impact on the surrounding environment. But there has been a great deal of variation in different states' requirements on such issues as design and groundwater evaluation. Federal guidelines are likely to cover siting, permeability and frequency of cover, liner and leachate removal, groundwater monitoring, and closure.

In March 1990, EPA extended the list of chemicals covered by the Resource Conservation and Recovery Act. Under the regulations, waste containing specified levels of such contaminants as chloroform and trichloroethylene, which are found in sludge and wastewater, will have to be disposed of and treated according to the federal hazardous-waste program. The concentrations were set at 6 mg/l for chloroform and 0.5 mg/l for trichloroethylene. The levels for these and 23 other organic chemicals were set to go into effect within six months of the announcement.

The tightening disposal situation has focused the industry on alternatives, including the conversion of waste to useful products. Fort Howard Corp. solved the sludge problem at its recycled tissue and towel mill in Green Bay, Wis., by sending the waste to a firm called GranTech to be converted into a carrier for fertilizer and pesticides.

Prime Fiber Corp. of Appleton, Wis., developed a process to convert 15% to 60% of a paper mill's sludge into market pulp. Prime Fiber plans to set up a plant in Appleton to process sludge from neighboring mills. Fibers recovered from mill effluent can also be burned. Willamette Industries Inc. is installing a primary water effluent clarifier and sludge press to retrieve fibers at its Campti, La., kraft linerboard mill. The fiber will be burned in a waste fuel boiler to cut down on fossil fuel requirements.

Recycling—both of plant waste and finished paper products—is also gaining in popularity as landfills top out. But it is not a free ride. Recycling plants generate their own share of wastes. And some warn that paper recycling is being driven less by demand than by forces on the supply side, such as legislation. Environmental legislation is gaining a keen following. Irene Meister, international vice president for API, said that hundreds of proposals are pending in state legislatures. They include bans on nonrecyclable or nondegradable products, source separation and recycling requirements, state purchasing preferences, and incineration and landfilling restrictions.

River color as well as odor and foam that result from running pulp mills are also being targeted by politicians. Currently, EPA has not set official river color standards, though some states have come up with their own for specific mills. Maine passed a bill in April 1990 to tidy up the state's rivers. Industry estimated the legislation, which limits color discharges to 225 lb/ton of pulp, would cost producers $200 million, though the state's Dept. of Environmental Protection put the bill closer to $54 million. Other states, such as Florida, regulate transparency.

The main source of color from pulp and papermaking processes is the lignin in the wood. Kraft pulping generates the most color—300 lb of color/ton for a bleached kraft mill, according to Brian Harrington of HDR Engineering and Richard Albert of Chas. T. Main Inc. Conventional primary and secondary effluent treatment is not especially helpful in eliminating color discharges because of the small particle size and chemical structure of the lignin residues. Treatments for color include salts or organic polymers used to coagulate the particles; the clumps are then retrieved and disposed of as sludge. Carbon absorption also has been studied but appears to be less economical. Filtering wastewater through semipermeable membranes is another alternative, but it is even more expensive.

Ultimately, Harrington and Albert believe that inplant process changes, recycling, and spill containment will replace such end-of-pipe treatments. Options here include conversion to oxygen delignification in bleaching, extended delignification, chlorine dioxide substitution, and better spill collection and recovery systems.

As far as odor is concerned, pulp and paper mills are pretty much on their own. Some states rely on ambiguous statutes, such as nuisance regulations, and others have set up odor panels. Some states have gone as far as setting limits on the amount of acceptable odor, but reliable equipment for continuous monitoring apparently is not available.

Sulfur compounds are particularly annoying pollutants because humans can smell them even at very low levels—possibly even in the parts-per-billion range. Mills' power plants put out sulfur dioxide, and digesters and evaporators release TRS.

Sulfur dioxide reduction strategies suggested by BE&K Engineering Co. include switching to low-sulfur fuels, wet scrubbing, or dry scrubbing. In wet scrubbing, the sulfur-dioxide-laden gases are washed with an alkaline solution or slurry, transferring the sulfur dioxide from gas to liquid. The sulfur dioxide is then converted to form marketable chemicals or to be landfilled. Dry scrubbers use a spray of lime or sodium slurry that dries almost immediately, forming a dry product. A newer method to cut release of sulfur compounds is the circulating fluidized bed boiler. Low-grade coal is used as the fuel, but lime is put into the boiler as well to act as an in situ type of control. Another way to reduce sulfur dioxide is to use lower-sulfur fuels, including more bark and waste, in power boilers.

Congress has been slowly working to develop a compromise update of the 1970 Clean Air Act that was amended in 1977. The goal of the legislation is to cut down on acid rain, smog, and emissions of toxic chemicals. Estimates for the cost of the bill were in the range of $20 billion per year—in addition to the $33 billion already spent by U.S. industry on compliance with environmental laws. And API said the toxic chemical provision of the bill could cost the pulp and paper industry $1 billion per year.

By May 1990, the Senate and House had each passed a version of the bill and then wrangled over the differences. In September, the Bush administration presented a compromise blending language of the two bills, generally favoring the least-expensive provisions.

United States:

PAPER MACHINERY

The paper machinery industry anticipates a fourth straight year of sustained growth in 1990, thanks to continued record capital spending in the paper industry. Shipments are forecast to rise 13% to over $2.4 billion, according to the Dept. of Commerce, while exports are expected to grow 21% to $775 million and imports to climb 15% to $1.04 billion. Paper machinery manufacturers anticipate a 10% increase in employment, substantial for the industry. More extensive subcontracting will help the industry avoid overexpansion, but the accompanying long lead times mean that many orders will not be shipped until 1991.

The U.S. paper machinery industry finally began to recover in 1986 from the battering it took after the recession of 1982. Record capital spending by pulp and paper companies at home and abroad lifted machinery shipments and trade to new highs. Domestic paper machinery manufacturers shipped products worth $1.3 billion in 1986, the first year to exceed the prerecession high. The industry has enjoyed double-digit increases every year since. Still shaken by their experiences in the early 1980s, however, manufacturers were slow to add new production capacity. Instead, they focused on research and development (R&D) and on improved service.

Spurred by a 38% increase in U.S. paper industry capital spending, American paper machinery shipments rose to new highs in 1989. After initially hesitating to expand, major paper machinery producers announced capacity

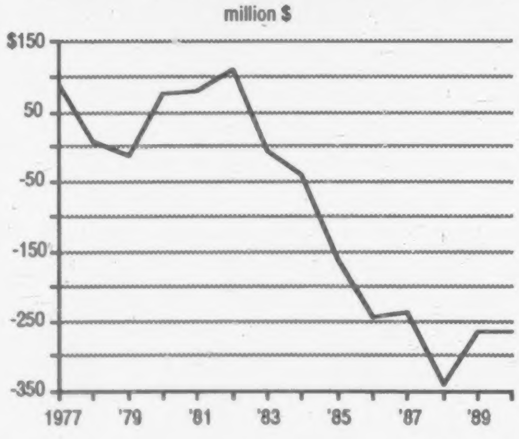
AD VALOREM TARIFFS CHARGED BY VARIOUS COUNTRIES ON IMPORTS OF PAPER AND BOARD MANUFACTURING MACHINERY

(Brussels Tariff Nomenclature 84-31)

Country	Current
U.S.[1]	Duty-free
Finland	5.10%
European Community	3.80%
Canada[2]	9.20%
Japan	
Paper	3.90%
Board	3.40%
Brazil	
If PM is made in Brazil	40.0% + 5% V.A.T.
PM not available in Brazil	20.0% + 5% V.A.T.

1. TSUS 66800.40 except for certain codes with tariffs of 2.4% (i.e., dryers and other specialized parts).
2. Tariff on U.S. machinery will be eliminated by 1993.

U.S. PAPER MACHINERY BALANCE OF TRADE



Source: Bureau of the Census, International Trade Administration.

increases and new R&D facilities. According to the Dept. of Commerce, U.S. paper machinery shipments rose an estimated 14% in 1989, to almost $2.2 billion. To meet the additional demand, manufacturers have turned to widespread subcontracting.

U.S. exports of paper machinery jumped dramatically in 1989 as new orders surged worldwide. Exports in 1989 were expected to reach a record $640 million, 50% above the previous year's record high of $428 million (some of the increase may reflect the switch to the more comprehensive Harmonized system of trade statistics, however).

The lower-value dollar since 1985 assisted U.S. exports while also contributing to the expansion of foreign-owned paper machinery firms in the U.S. Canada remains the principal export market for U.S. paper machinery makers, who will be further aided by the Free Trade Agreement, which will eliminate tariffs in both directions. The Soviet Union and Eastern Europe may offer long-range prospects for U.S. paper machinery, although competition from Finland and Fed. Rep. Germany will be intense.

Import growth has slackened but not enough to eliminate the deficit of trade since 1982-83. After a 41% increase in 1988, imports of paper machinery reached $904 million in 1989, an 18% increase and a new record high. The increased level reflects strong demand and success by foreign firms in securing additional U.S. orders. Fed. Rep. Germany continues as the leading source of U.S. imports, followed by Canada and Finland. Brazil has become a significant source of U.S. paper machinery imports as a result of extensive government financial support of exports.

The first half of the 1990s holds major challenges for the paper machinery industry in increasing exports. Machinery to manufacture fine writing papers and highly supercalendered grades used in magazines will see good growth, according to the Commerce Dept. Orders for newsprint using virgin pulp may decline, but recycled newsprint legislation and demand for additional deinking facilities in the U.S. and Canada will assist the industry through the 1990s.

The U.S. is the world's largest producer of paper machinery, with shipments about four times as high as the next level of producers—Canada, Finland, and Fed. Rep. Germany. On a somewhat lower level are the U.K., France, and Italy, followed by Sweden, Switzerland, Brazil, and Japan. Of this group, Japan and Brazil showed the most rapid growth in capacity during the past decade.

Manufacturers in Fed. Rep. Germany were the dominant force in the world market during the 1980s. In 1985 alone, its exports of $644 million exceeded those of U.S., Italian, and Japanese manufacturers combined. The U.S. has maintained its hold on second place, with a share that declined from 15% in 1981 to 10% in 1985. Over the same period, Japan and Italy raised their shares of world exports to third and fourth place, respectively.

The U.S. balance of trade in paper machinery declined throughout the 1970s, culminating in the industry's first deficit in 1979. After recovering in 1980-81, the trade balance turned negative again following the recession of 1982. Exacerbated by the strong U.S. dollar, the deficit hit bottom in 1986 at $242 million.

Machinery parts and box-making machinery were the major contributors to the deficit during the 1982-86 period, according to the Dept. of Commerce. Over that five-year period, exports of machinery parts fell from $179 million to $169 million, while imports rose from $97 million to $197 million. This translated a surplus of $72 million into a deficit of $28 million. Box-making exports rose slightly from 1982 to 1986—from $19 million to $22 million—but imports shot up from $37 million to $92 million during the same period.

Three price-related factors hindered U.S. paper machinery exporters in the early 1980s: the strong U.S. dollar, effective foreign export financing arrangements, and lower foreign production costs. Since 1985, however, the decline in the dollar and improved credit arrangements by Eximbank have strengthened the U.S. trade balance. In order to sustain competitiveness over the long term, U.S. manufacturers must invest heavily in productive capacity and in research and development, where the industry has been matched or outpaced by overseas competitors.

Trade in papermaking machinery is quite sensitive to exchange rates, with a one- to two-year lag in their effects on trade. The strong dollar helped foreign suppliers make inroads in the U.S. market during the early 1980s; it also depressed exports of U.S. machinery. The weaker dollar of the late 1980s gave a strong boost to U.S. manufacturers' exports, and it encouraged overseas suppliers to establish bases in the U.S. as the best way to maintain their newly won market share. Foreign companies have used acquisitions, joint ventures, and licensing agreements to produce machinery in the U.S. that formerly was imported.

CATEGORIES OF PAPER MACHINERY*

Wood preparation. Machinery involved from the receipt of rough wood at the mill yard to delivery of prepared wood or chips to the pulp mill.

Pulp manufacturing. All equipment required for processing wood or other raw fiber into pulp for delivery to stock preparation, including chemical recovery equipment.

Pulp refining. Processing of pulp fiber for delivery to the paper machine(s).

Paper and paperboard manufacturing. From the headbox through the machine winder.

Finishing. Supercalenders, winders, sheeters, and sheet and roll wrapping equipment.

Converting. Coaters, laminators, embossers, saturators, corrugators, and fabricating equipment . . . boxes, cores, bags, envelopes.

*Based on classification scheme proposed by the Pulp & Paper Manufacturers' Assn. for use by the Bureau of Census in collecting statistical information.

The U.S. will probably continue to suffer a negative trade balance in the paper machinery area for several years, particularly if the dollar continues to strengthen as it did during 1989.

U.S. machinery makers sometimes compete with their own overseas operations. Many companies, both U.S. and European, have established foreign manufacturing subsidiaries and licensees to take advantage of cheap labor, proximity to major markets, or government incentives. Such moves tend to blur the distinctions between countries of origin. Thus, a contract for a new paper machine to be installed in Canada was awarded in 1987 to the Brazilian subsidiary of a European manufacturer. And earlier in the decade, a new paper machine installed in the U.S. was supplied by the Japanese licensee of a U.S. manufacturer.

The U.S. phased out tariffs on imported pulp and paper machinery in 1987, except for a 2.4% toll on certain machine components, such as dryers and other specialized parts. U.S. suppliers are still subject to tariffs in many countries, including Finland, Canada, the European Community, Japan, and Brazil. (Canada's old 9.2% tariff on U.S. paper machinery will be phased out by 1993.)

Mergers and acquisitions. In 1986, Harnischfeger Corp. purchased Beloit Corp., the largest U.S. paper machinery maker. An infusion of capital allowed Beloit to expand and modernize its facilities, and since then the company has taken advantage of the capital spending boom in the paper industry. Beloit operates manufacturing plants in five countries: the U.S., Canada, the U.K., Italy, and Brazil. Through its Brazilian operation, in particular, Beloit has offered government-supported financing and export incentives that make it easier to compete with other paper machine makers. Beloit also maintains licensing agreements with manufacturers in several countries, most notably Mitsubishi Heavy Industries of Japan.

Black Clawson Co., the second-largest U.S. pulp and paper machinery manufacturer, remains independent. Owned by closely held Parsons & Whittemore Inc., Black Clawson has manufacturing operations in the U.S., Canada, France, and the U.K.

Two of the top pulp machinery manufacturers were combined in 1986. Combustion Engineering Inc. purchased the Sprout-Waldron Div. of Koppers Corp. and merged it with its C-E Bauer unit, creating C-E Sprout-Bauer. In early 1987, Combustion Engineering extended its reach into the paper machinery market with the purchase of AccuRay Corp., one of the largest U.S. makers of process control equipment. Also in early 1987, Beloit formed a sales alliance with Measurex Corp., the other large process control supplier. Measurex struck a similar deal with Mitsubishi of Japan in late 1988.

Among foreign suppliers, Sunds Defibrator (a subsidiary of Svenska Cellulosa AB of Sweden) acquired Rauma-Repola Oy's chemical pulping division in 1988 for an undisclosed amount. In 1987, Sunds tried to buy the Impco Div. of Ingersoll-Rand of the U.S., but that deal fell through when the Federal Trade Commission expressed concern about the merger and Ingersoll decided not to pursue the discussions.

Early in 1986, Valmet Oy of Finland and KMW AB of Sweden formed Valmet-KMW AB to manufacture paper machinery. The company is based in Sweden and is 75% owned by Valmet and 25% owned by KMW. Valmet produces paper machines for newsprint and fine papers, while KMW manufactures tissue machines, kraft packaging paper machines, and pulp drying machines. Valmet also acquired some of Wärtsilä AB's facilities in the U.S.

In 1987, Bird Inc. of the U.S. and Sulzer Escher Wyss of Ravensburg, Fed. Rep. Germany (a unit of Sulzer Group of Switzerland), entered into a multimillion-dollar joint venture, creating Bird Escher Wyss. The venture sells pulp and paper machinery and systems of both companies in North America, and it will develop new systems for sale worldwide. In August 1989, Bird agreed to sell its 49%

MANUFACTURERS BY COUNTRY OF NEW PAPER MACHINES STARTED UP IN U.S., 1981-89

(Number of machines)

Manufacturer	1981/82	1983	1984	1985	1986	1987	1988	1989	Beyond 1989	Total
Beloit (U.S.)	6	1	2	1	4	2	3	2	8	29
Manchester (U.S.)	—	—	—	—	—	1	—	—	—	1
KMW (Sweden)	1	—	—	—	—	—	—	—	—	1
Sulzer-Escher Wyss (Fed. Rep. Germany)	—	—	—	1	1	—	—	1	1	4
Tampella (Finland)	3	—	—	1	—	—	—	—	1	5
Valmet (Finland)	5	1	—	—	1	—	1	2	6	16
Voith (Fed. Rep. Germany)	1	—	1	1	2	1	2	1	1	10
Total U.S.	6	1	2	1	4	3	3	2	8	30
Total foreign	10	1	1	3	4	1	3	4	9	36

Source: *Pulp & Paper Project Report.*

stake in the joint venture to Sulzer.

In May 1988, Valmet integrated Valmet-Dominion, Valmet-KMW, and Valmet-Appleton into a single North American division to improve its service to pulp and paper customers. Valmet has also invested heavily in its Brazilian subsidiary to diversify into making equipment for paper production and automation.

In August 1989, Sulzer Escher Wyss and privately held Voith agreed to merge operations in the areas of paper technology and fluid flow technology, citing increased globalization in the field and the tendency toward increased concentration in the industry. Later in the year, Asea Brown Boveri Group Ltd. announced plans to acquire Combustion Engineering Inc. for $1.6 billion.

In 1990, Ahlstrom Corp. of Finland purchased Sandy Hill Corp. and acquired a controlling interest in the Kamyr group. Measurex Corp. and Harnischfeger Industries strengthened their relationship in the process control area with an agreement under which Harnischfeger will own up to 20% of Measurex. In July 1990, instrumentation and controls maker Foxboro Co. agreed to a $656-million merger with Siebe plc of the U.K.

PAPER INDUSTRIES MACHINERY SHIPMENTS, EXPORTS, AND IMPORTS, 1977-90

(million $)

				Ratios	
Year	Shipments[1]	Exports	Imports	Imports/ new supply[2]	Exports/ shipments
1990f	2,440	775	1,040	0.299	0.318
1989e	2,157	640	904	0.295	0.297
1988	1,890	426	768	0.289	0.225
1987	1,612	308	544	0.252	0.191
1986	1,296	269	511	0.283	0.208
1985	1,152	251	411	0.263	0.218
1984	1,130	259	301	0.210	0.229
1983	1,021	203	210	0.171	0.199
1982	1,199	316	207	0.147	0.264
1981	1,177	351	273	0.188	0.298
1980	1,177	318	242	0.171	0.270
1979	1,017	233	246	0.195	0.229
1978	799	192	184	0.187	0.240
1977	698	184	95	0.120	0.264

e = Estimate.
f = Forecast.
1. Value of paper machinery produced by all U.S. industries.
2. New supply = product shipments + imports.
Source: Census Bureau, International Trade Administration.

Canada:

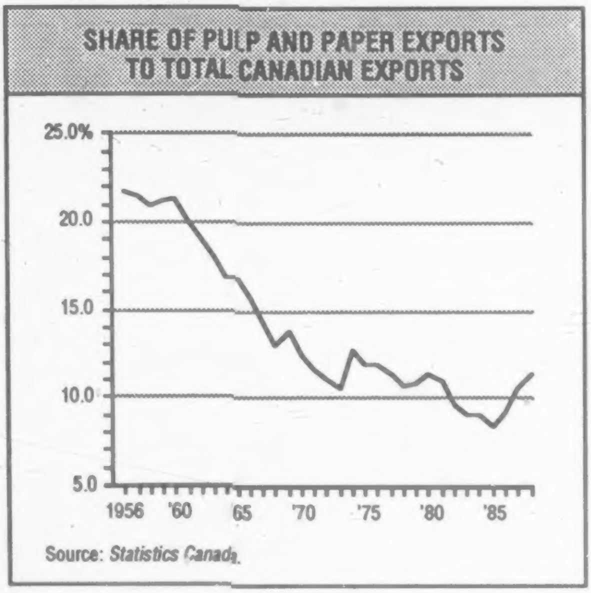
INDUSTRY STRUCTURE

Manufacture of pulp, paper, or paperboard in Canada is done by 65 separate operating companies that control more than 145 pulp, pulp and paper, or paper and board mills. Some of these companies are interrelated. About 25% of the mills produce pulp only; 25% produce paper only, some using secondary fiber to a lesser or greater extent; and the rest are integrated pulp and paper mills. (Companies with combined pulp and paper capacity of 1,000 tpd or more are listed in the Company Profiles section.)

Canadian Pulp & Paper Assn. Reference Tables indicate that there were 142 mills in 1984, one more by 1986, and a number are under construction now, though those are mostly pulp mills. During the past 35 years, this figure has fluctuated, rising from 123 facilities in 1950 to a high of 147 facilities in 1976. The Statistics Canada annual "Pulp and Paper Industries" census of manufactures includes those establishments primarily engaged in manufacturing pulp, paper, paperboard, and building and insulation board.

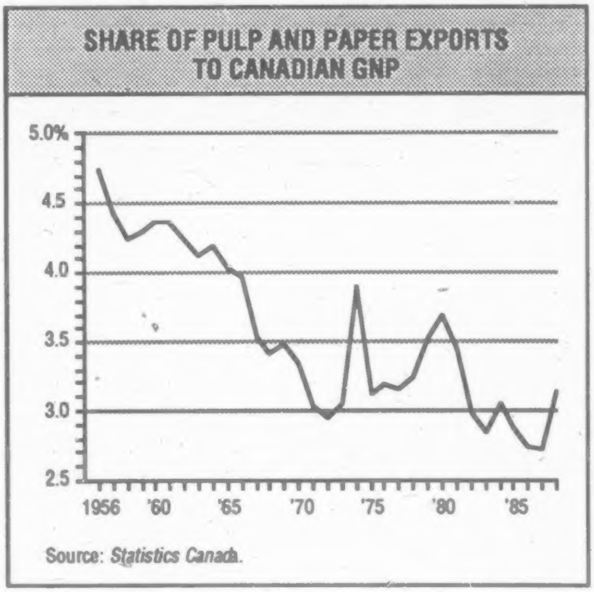
CPPA says there are 145,000 persons employed directly by the pulp and paper industry and another 300,000 persons whose jobs are indirectly generated by the industry. CPPA's Reference Tables suggest a 1987 employment level of 80,334, up from 79,570 in 1986. Wages were valued at C$3.1 billion in 1987, up $100 million from the year before.

Pulp and paper mill workers earned an average of $697.16/week in 1985, the fifth-highest of any major Canadian industry. The next closest group was motor vehicle



SHARE OF PULP AND PAPER EXPORTS TO TOTAL CANADIAN EXPORTS

Source: *Statistics Canada.*



SHARE OF PULP AND PAPER EXPORTS TO CANADIAN GNP

Source: *Statistics Canada.*

workers, who made $719.12/week. In 1987, pulp and paper mill employees got a 2.6% raise to $715.59/week.

Quebec has the largest number of mill sites and highest total output. In 1988, Quebec mills produced almost 7.1 million tons of paper and paperboard (excluding building board) at 35 sites. Ontario, its closest rival in terms of locations, with 19 mill sites, had estimated production of 4.2 million tons in 1988. British Columbia ranked third, with almost 2.9 million tons at eight sites. Remaining provinces produced almost 2.4 million tons at 14 locations.

Quebec also led in output of woodpulp in 1988, producing 7.5 million tons. British Columbia is a close second with over 7.2 million tons, Ontario produced just over 4.4 million tons, and the remaining provinces together manufactured almost 4.5 million tons.

By far, the largest segments of the Canadian industry are newsprint and woodpulp (including market pulp). Canada historically has been the world's largest producer of newsprint, with production for 1989, 75% more than the U.S., its closest rival and largest customer. This ranking is reversed in the case of woodpulp production. As the world leader, the U.S. produces two-and-a-half times as much pulp as Canada. These two commodities represented almost 84% of total estimated 1989 pulp, paper, and board production for the Canadian industry.

Exports, representing more than 93% of all shipments in 1989, are far more important to the Canadian industry than domestic shipments. Pulp and paper exports had been Canada's most important generator of export revenues until 1983, when they were eclipsed by the automobile industry, which remains number one. Industry dollar revenues for 1988 totaled some C$20 billion, with exports accounting for $15 billion of that total.

At $1.9 billion in 1986 (the latest figures available), pulp and paper was the largest Canadian manufacturing industry in terms of gross wages and salaries paid, total employment, and value added by manufacture. In terms of the selling value of factory shipments, pulp and paper was third behind the petroleum and motor vehicle industries. Pulp and paper, as well as other forest products, make an enor-

PULP, PAPER, AND BOARD MILLS IN CANADA

(Number of mill sites)*

	Paper/board mills[1]	Pulp mills
Alberta	4	6
British Columbia	13	34
Manitoba	4	5
New Brunswick	7	14
Newfoundland	3	5
Nova Scotia	4	6
Ontario	34	36
Quebec	55	68
Saskatchewan	2	1
Total	126	175

*One or more pulp mills may be located at the site of a paper/paperboard mill. Total pulp mills shown.

1. Molded pulp products not included in tabulations.

Source: *1990 Lockwood-Post's Directory.*

LEADING CANADIAN FIRMS

(Canadian companies ranked among the top 150 worldwide in paper industry sales)

World rank	Company	1989 paper industry sales* (million $)	% change 1989/88	% of total sales from paper industry operations	1989 production (000 metric tpy) Market pulp	Paper/ board	Converted products
19	Noranda Forest	2,364.5	10.8	61.7	1,208	2,493	—
20	Canadian Pacific Forest Products	2,154.2	10.9	88.2	933	396	—
33	Consolidated-Bathurst	1,490.7	5.4	77.3	335	1,065	—
34	MacMillan Bloedel	1,472.8	9.8	55.4	480	699	268
36	Abitibi-Price	1,462.6	5.9	54.5	—	2,451	—
41	Domtar	1,374.0	11.4	62.6	275	1,220	—
73	E.B. Eddy Forest Products	585.6	22.3	91.4	374	327	69
84	Donohue	526.8	27.1	100.0	300	521	—
88	Quebec & Ontario Paper	447.9	10.0	94.3	—	732	—
94	Cascades	397.3	6.3	83.0	118	630	—
98	Rolland	361.8	14.8	100.0	—	143	—
102	Canfor	336.8	-13.8	38.2	455	101	—
137	Eurocan Pulp & Paper	197.5	8.5	63.8	—	361	—

* = Sales from pulp, paper, and converting operations only.

n.a. = Not available.

Source: *Pulp & Paper International.*

mous contribution to Canada's balance of trade. In 1987, Canada exported forest products valued at $22.4 billion.

In recent years, various forestry practices have evolved to ensure adequate pulpwood supplies in the future. For example, joint industry-provincial government forest management agreements established a framework for companies to harvest Crown-owned timberlands. Tree seedlings planted in Canada have grown from 245 million in 1980 to over 800 million/year currently.

The outlook for world consumption of paper and board is bright, with projections for the year 2000 amounting to three times the current size of the entire Canadian paper and board industry. Canadian mills have some competitive advantages in certain market niches. In addition, the dismantling of trade barriers after passage of the Canada-U.S. Free Trade Agreement and the General Agreement on Tariffs and Trade gives a further boost to Canadian exporters.

Canada is likely to remain the world's largest pulp exporter, with projected expansions amounting to an annual capacity growth rate of 4.3% from 1988 through 1991. Although Canada's world market share in newsprint has been easing downward for several years, its capacity in this sector will grow about 3.6%/year in the 1988-91 period.

Despite the pulp and paper industry's outstanding performance relative to other industries, its importance to the Canadian economy in general and to Canadian exports in particular has fallen over the last 35 years. Pulp and paper production in 1987 represented just 3.1% of the gross national product, down from 5.3% in 1950. Industry exports as a percentage of foreign trade dropped even more significantly, falling from 22.9% in 1950 to a low of 8.4% in 1985. However, the ratio moved up to 9.3% in 1986, followed by another jump to 10.5% in 1987, and 11.5% in 1988.

TEN LEADING CANADIAN MANUFACTURING INDUSTRIES, 1986*

	Number of employees	Wages, salaries (C$000)	Selling value of shipments (C$000)
Pulp and paper mills	53,330	C$1,948,610	C$11,270,926
Motor vehicle industry	41,607	1,555,854	24,286,602
Sawmills, shingle, and planing	48,303	1,345,759	7,386,614
Other machinery/equipment	21,443	749,993	4,595,599
Primary steel industries	32,359	1,177,509	7,386,239
Meat and poultry products	24,056	591,572	8,530,573
Commercial printing industries	39,849	982,263	4,110,508
Industrial chemicals industries	6,302	276,103	4,350,992
Refined petroleum products	5,227	232,528	15,145,368

* Latest available.
Source: *Statistics Canada.*

Canada:

PRODUCTION, EXPORTS, AND IMPORTS

Cyclicity is the byword in the paper industry, and it holds as true for Canadian mills as it does for U.S. mills. That is evidenced by the swings in production during the 1980s. The decade started with two off years, but then Canadian mills began to recover in 1983, and that rebound continued strongly for most grades in 1984. However, production headed south again in 1985, but it picked up in 1986 and lasted through 1988, with new records set each year. Softening demand and overcapacity caused some problems in 1989 and 1990, though the latter year was stronger overall.

Canadian mills produced about 13.6 million metric tons of paper and board in 1979, dropping by about 150,000 tons in 1980. Output again topped 13.6 million tons in 1981, only to tumble by over 1 million tons the next year. In 1983, production approached the 1980 level, capping the year at more than 13.3 million tons.

In 1983, output showed the first signs of a recovery that would boost production to 14.2 million tons by the end of 1984. In the two years that followed, levels moved up even higher. At year-end 1986, the Canadian industry had reason for jubilation as production set an all-time record of just over 15 million tons, a 5.5% increase from the previous year. That growth continued in 1987 with a 5% increase to over 16 million tons, followed by a 4% boost in 1988 to a new high of more than 16.6 million tons. However, the somewhat weaker 1989 fell to just over 16.5 million tons, with mid-year 1990 production already rising by almost 2% over 1989.

Newsprint, newsprint everywhere. Canada's important newsprint sector began a recovery period in 1983; allowing for a slight correction in 1985, it has mirrored the rise in the rest of the paper and board industry. The greatest growth in year-to-year levels occurred from 1983 to 1984, when production expanded by 6.2%. This performance was not repeated during the next year, however, when production declined 0.3% from the record levels of 1984 due to

CANADIAN PRODUCTION OF PULP AND PAPER/PAPERBOARD BY PROVINCE, 1988r

(000 metric tons)

Pulp		Paper/paperboard*	
Quebec	7,542	Quebec	7,112
British Columbia	7,236	British Columbia	2,878
Ontario	4,448	Ontario	4,214
Others	4,471	Others	2,440
Total	23,697	Total	16,644

* Excludes building board.
r = Revised.
Source: Canadian Pulp & Paper Assn. estimates.

CANADIAN DOLLAR VALUE IN U.S. DOLLARS

(average for year)

Year	C$ = US$	Year	C$ = US$
1990*	0.855	1980	0.855
1989	0.845	1979	0.854
1988	0.812	1978	0.877
1987	0.754	1977	0.938
1986	0.720	1976	1.014
1985	0.733	1975	0.982
1984	0.733	1974	1.022
1983	0.812	1973	1.000
1982	0.811	1972	1.000
1981	0.834		

*Through first nine months.
Sources: *Pulp & Paper Pricebook*; *Pulp & Paper Week*.

softer markets and the strong U.S. dollar. From 1985 to 1986, the trend reversed again as newsprint production posted a 3.2% gain, finishing the year at almost 9.3 million tons. In 1987, a 4% increase brought output to nearly 9.7 million tons, followed by another 3% boost in 1988 to about the 10-million-ton mark. Production in 1989 was off almost 3%, and by mid-year 1990, production levels were down another 2% from 1989. Toward the end of the third quarter, however, producers were reporting tight markets because of fears of labor-related shortages.

Operating rates for the newsprint industry have been steadily climbing since their slump in 1982-83, breaking the 90% barrier in 1984 and 1985. The upturn continued with rates of 94% in 1986, 97.5% in 1987, and 99% in 1988. Rates dropped to 94% in 1989, however, even though at the beginning of 1989 newsprint mills sold about as much as they could make, especially because capital spending levels required equipment downtime. Additional capacity coming online during 1989-91 was expected to lower operating rates to less than 90%, according to estimates.

Newsprint's companion grades—uncoated groundwood specialties—have increased in output every year since 1979, with old newsprint machines being converted to produce the more profitable groundwood grades making up most of the new tonnage. Production jumped 19.7% from 1983 to 1984, 14.6% from 1984 to 1985, 15% from 1985 to 1986, and 11.3% from 1986 to 1987. Groundwood ma-

CANADIAN PAPER AND PAPERBOARD PRODUCTION BY MAJOR GRADES, 1979-89

(000 metric tons)

PAPER

							Operating rates	
Year	Newsprint	Groundwood printing, specialties	Book and writing	Kraft papers	Tissue, special papers	Total paper	Newsprint	Other papers
1989	9,678	1,161	1,550	525	487	13,401	94%	79%
% change year ago	-2.9%	-21.4%	8.8%	-7.6%	0.0%	-3.8%		
1988	9,969	1,477	1,424	568	488	13,926	99	94
1987	9,669	1,340	1,297	567	456	13,329	98	93
1986	9,288	1,221	1,179	541	459	12,688	94	100
1985	8,988	1,050	1,093	487	447	12,065	92	97
1984	9,013	916	1,027	430	399	11,785	92	94
1983	8,486	765	961	472	385	11,069	85	88
1982	8,117	649	831	453	375	10,425	82	82
1981	8,946	645	787	490	388	11,256	94	83
1980	8,625	614	895	533	377	11,044	94	88
1979	8,709	611	914	588	381	11,203	97	99

PAPERBOARD

	Containerboard						
Year	Total	Linerboard	Corrugating medium	Boxboard	Total paperboard	Total paper and paperboard	Operating rate, paperboard
1989	1,945	1,218	726	729	2,674	16,555	92%
% change year ago	-1.8%	-3.9%	1.7%	0.8%	-1.1%	-0.5%	
1988	1,981	1,267	714	723	2,704	16,643	97
1987	1,955	1,255	701	742	2,697	16,044	100
1986	1,847	1,199	648	726	2,573	15,261	97
1985	1,677	1,126	551	697	2,374	14,439	89
1984	1,695	1,087	608	745	2,440	14,225	92
1983	1,573	1,022	551	711	2,284	13,353	88
1982	1,365	887	478	618	1,983	12,408	74
1981	1,646	1,088	558	701	2,347	13,603	89
1980	1,671	1,175	496	673	2,344	13,388	95
1979	1,541	1,075	466	742	2,283	13,486	91

Source: Canadian Pulp & Paper Assn.

chines produced more than 1.3 million tons of paper in 1987 and approached 1.5 million tons in 1988, compared with just over 600,000 tons at the beginning of the decade. By 1989, production was up to about 1.6 million tons.

The book and writing papers segment also regained ground lost in the recession years of the early 1980s. Production increased 6.4% from 1984 to 1985, compared with 6.8% from 1983 to 1984. A 7.9% increase in 1986 brought levels up to almost 1.2 million tons, and another 10% boost in 1987 moved this sector to nearly 1.3 million tons. Production in 1988 rose about 100,000 tons, topping 1.4 millions tons, and new capacity from Domtar Inc., Canadian Pacific Forest Products Ltd., and Weyerhaeuser Canada Ltd. brought 1989 and 1990 production even higher.

Tissue production jumped 12% from 1984 to 1985, but the growth rate slowed to 4.0% in 1986, bringing output up to 465,000 tons. This level remained about the same in 1987, before climbing 7% to 488,000 tons in 1988 and falling 1,000 tons in 1989.

Kraft paper production dropped steadily in the early 1980s, briefly rising by about 4% in 1983 but dropping again by 8.9% in 1984. A rally began in 1985 as production increased by just over 13%. This was followed by another jump of 10.9% to 540,000 tons in 1986 and by further growth of 4.8% to 567,000 tons in 1987. Output increased by another 1,000 tons in 1988 but declined 43,000 tons in 1989.

Paperboard ups and downs. While kraft paper performed badly in the early and late 1980s, containerboard was on a roller coaster ride. Output rose in 1980, fell modestly the next year, and tumbled by 13.3% in 1982, only to bounce back by the same amount in 1983. In 1984, a record 1.69 million tons was produced, up 7.8% from the previous year. As with other grades, 1985 figures could not stand up to those 1984 records, and levels dropped by just over 1% to finish the year at 1.68 million tons. A strong turnaround in 1986, with an increase of 10.1%, boosted production to almost 1.85 million tons. This was followed in 1987 by a 5.8% jump to 1.9 million tons, rising slightly to close at 2 million tons in 1988 but dropping 36,000 tons in 1989.

Operating rates for paper grades, excluding newsprint and paperboard, were 98% in 1988 but dropped to 90% in 1989, according to the Canadian Pulp & Paper Assn. Paperboard grades also declined, with a 1988 operating rate of 97% falling to 93% in 1989.

Boxboard production zigzagged during the entire decade, dropping in 1980, rising in 1981, falling the next year, and bouncing back in 1983. The rising trend continued into 1984 before reversing course and dropping 6.4% in 1985. Still on a seesaw, output figures rose 4.2% in 1986 to finish the year at 726,000 tons. Production rose again in 1987 by a modest 2.2% to 742,000 tons. In 1988, the cycle changed once again when output fell by 2.7% to 723,000 tons but added 6,000 tons in 1989.

Pulp posts steady gains. The Canadian woodpulp industry, which shares top billing with the newsprint sector, has steadily increased production since the nearly 12% slump between 1981 and 1982. Increased worldwide demand and currency valuations favorable to Canadian producers have contributed to the strength in market pulp exports, while healthy demand for paper and board products has kept up production for internal use. Concern with pulpwood supplies and interest in recycling are becoming important factors in determining future pulp production.

Market pulp output was slightly up in 1988, totaling 8.204 million metric tons, compared with 8.084 million tons a year earlier. Total woodpulp production, however,

CANADIAN PAPER AND PAPERBOARD EXPORTS BY MAJOR GRADES, 1979-89

(000 metric tons)

						Containerboard				
Year	Newsprint	Groundwood printing	Book, writing	Kraft papers	Tissue	Total	Linerboard	Corrugating medium	Boxboard	Total Paper/ paperboard
1989	8513	1385	673	331	82	561	393	248	101	11,726
% change year ago	-1.5%	10.4%	37.3%	-1.8%	5.1%	3.1%	24.4%	9.3%	48.5%	2.8%
1988	8,641	1,254	490	337	78	544	316	227	68	11,411
1987	8,574	1,139	432	320	64	544	325	219	80	11,153
1986	8,180	1,032	311	300	61	529	329	200	66	10,479
1985	7,964	900	278	237	56	422	280	143	61	9,919
1984	7,949	767	252	192	38	475	267	207	76	9,748
1983	7,469	636	239	234	24	461	268	193	57	9,120
1982	7,139	546	174	218	24	356	220	136	28	8,485
1981	7,871	524	127	207	26	400	256	114	40	9,165
1980	7,642	517	201	241	24	458	346	112	38	9,121
1979	7,783	486	204	240	33	350	254	96	64	9,160

Source: Canadian Pulp & Paper Assn.

was up 2.3% to 23.8 million tons. Dissolving and special alpha was the leading sector with over a 10% increase. In the paper-grade pulp segment, the biggest hike—6.2%—was recorded in bleached hardwood kraft. The largest segments, bleached softwood kraft and mechanical pulp, posted increases of 1.2% and 5.0%, respectively. Operating rates for chemical paper-grade pulp mills—half of the total industry—jumped from 87% in 1984 and 1985 to 92% in 1986 and 96% in 1987. Despite strikes at three eastern Canadian mills, the operating rate was 98% in 1988, but that tumbled to 92% in 1989.

EXPORTS REACH RECORD LEVELS

Newsprint and market pulp are the largest export groups in Canada's forest products trade, helping make Canada the world's largest exporter of pulp and paper, accounting for almost one-third of all international trade in those products. In 1988, total pulp and paper exports reached a record level of 15.4 million tons, 15.8% higher than in 1987. Canadian products benefited on the world market from weakness in the Canadian and U.S. dollars.

Export tonnage of most grades of paper and paperboard advanced 2% in 1989, substantially below the growth rates posted in earlier years. The bulk of the problem was in newsprint, which fell 1.5% overall and 4.1% in shipments to the U.S., according to preliminary CPPA figures. Another disadvantage for Canadian producers was the rise in the value of the Canadian dollar against the U.S. dollar, which reduced producers' competitive position and margins (see Profitability chapter). Almost 20 million tons of pulp, paper, and paperboard were shipped out of Canada in 1989.

The biggest export growth in 1989 was posted by the small (102,000 tons) boxboard segment, which grew 52% compared to 1988. That was followed by the much

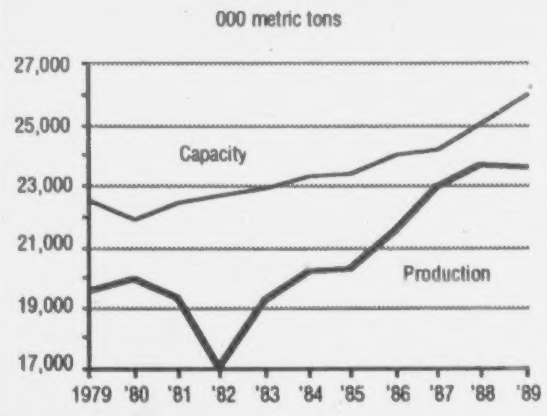
CANADIAN NEWSPRINT EXPORTS BY DESTINATION, 1979-89

(000 metric tons)

Year	U.S.	U.K.	Other Western Europe	Latin America	Asia	Other countries	Total
1989	6,799	466	278	350	422	199	8,514
% change year ago	-4.1%	32.0%	21.4%	-10.9%	-2.8%	37.2%	-1.5%
1988	7,087	353	229	393	434	145	8,641
1987	7,087	327	214	420	388	138	8,574
1986	6,734	293	175	416	354	208	8,180
1985	6,674	274	74	327	455	159	7,963
1984	6,586	376	143	357	355	132	7,949
1983	6,033	502	163	428	246	97	7,469
1982	5,614	541	170	471	240	103	7,139
1981	6,062	541	189	625	356	98	7,871
1980	6,117	442	181	518	267	116	7,641
1979	6,347	398	187	445	247	159	7,783

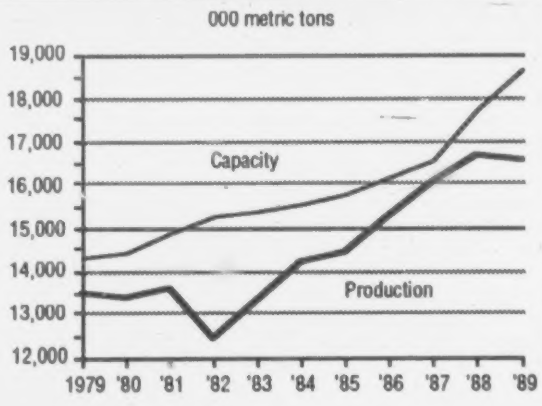
Source: Canadian Pulp & Paper Assn.

TOTAL PULP PRODUCTION VS CAPACITY



Source: *Statistics Canada*

TOTAL PAPER AND PAPERBOARD PRODUCTION VS CAPACITY



Source: *Statistics Canada*

larger (674,000 tons) book/writing papers segment, which shot up by nearly 35%, primarily due to large capacity expansions. Exports of kraft paper for bags and sacks dropped 2% to 331,000 tons.

Exports of uncoated mechanical printing papers (groundwood printing/specialty grades), accounting for exports of 1.385 million tons in 1989, advanced 10%. This sector, in general, has been strong since the beginning of the decade, as Canadian companies increased their capacity in response to market conditions. In newsprint, however, the Canadians have gradually lost market share in the global marketplace.

Woodpulp exports dropped 1% in 1989, ending the year at 8.3 million tons. The volume leader in the group continued to be bleached softwood kraft pulp, although growth fell 13.3%. This decline followed three years of growth, though softening was much evident in 1988.

Western Europe regains prominence. The U.S. continues to be the most significant market for the important Canadian exports of newsprint and market pulp. However, exports to European Community countries in western Europe, after declining during the 1982-85 period, showed healthy increases during 1986-89, due to the Canadian dollar's position against European currencies.

In 1986, newsprint exports to this region (excluding the U.K.) increased 136.5% to 175,000 tons, and woodpulp exports increased by a less astounding 17.7% to 1.7 million tons. In 1987, newsprint exports rose a healthy 23.4% to 214,000 tons, while woodpulp exports remained relatively flat, moving up just under 1% to 1.8 million tons. By 1988, the momentum in shipments of newsprint to this region had eased slightly, posting a 7% gain to 229,000 tons. Pulp exports picked up 4.5% to 1.9 million tons. Newsprint exports in 1989 to Western Europe jumped 21.4% to 278,000 tons, while pulp rose 6.0% to just over 2.01 million tons.

In 1988, Asia became the largest market for Canadian newsprint after the U.S., easing Latin America out of second position but dropping behind the U.K. again in 1989. Exports to Asia during 1988 reached approximately 434,000 tons—an increase of 11.9%. This followed a healthy jump of 27.2% in 1987 and a 1.4% advance in 1985. In 1989, Asia imported 2.8% fewer tons, dropping to 422,000 tons.

Latin America's potential as a leading customer of Canadian newsprint suppliers is undependable. Export levels to that region had been rising in recent years, but they began declining again in 1988, dropping 6.4% to 393,000 tons that year and 10.9% to 350,000 tons in 1989. During the previous two years, demand appeared to be on an upswing after a five-year downturn between 1981 and 1986, when shipments plunged from 625,000 tons in 1981 to 327,000 tons in 1985.

Japan has become an increasingly important consumer of Canadian woodpulp. Exports to that country rose 15.5% to 911,000 tons in 1986, 12.6% to 1.03 million tons in 1987, 5.7% to 1.09 million tons in 1988, and 9.8% to almost 1.3 million tons in 1989. Exports to other countries, including the rest of Asia and Africa, are the next most important market, with 833,000 tons shipped to these regions during 1989. These exports have more than doubled since 1981. Since the major focus in the Canadian pulp and paper industry is on production for export as well as for domestic use, imports have never played a significant role in the total picture.

CANADIAN WOODPULP PRODUCTION BY MAJOR GRADES, 1982-89

(000 metric tons)

Year	Total sulfite*	Bleached softwood sulfate	Bleached hardwood sulfate	Total sulfate**	semichemical	Total chemical	Total mechanical	Total woodpulp	Operating rate
1989	1,627	6,868	1,577	10,850	432	12,477	10,506	23,701	92.1%
% change year ago	-0.6%	1.2%	6.3%	0.7%	-3.6%	0.5%	6.1%	2.9%	
1988	1,739	6,970	1,407	10,934	424	12,673	10,422	23,801	95.1
1987	1,750	6,887	1,324	10,854	440	12,605	9,820	23,123	95.3
1986	1,676	6,324	1,299	10,221	406	11,897	9,253	21,798	90.7
1985	1,598	5,873	1,174	9,600	330	11,198	8,714	20,481	87.4
1984	1,771	5,568	1,214	9,316	410	11,087	8,682	20,417	87.6
1983	1,657	5,705	1,035	9,248	382	10,904	7,938	19,455	85.0
1982	1,726	5,098	817	8,066	319	9,792	6,888	17,237	76.2

*About 75% is unbleached.

**Includes semibleached sulfate.

Source: Canadian Pulp & Paper Assn.

CANADIAN WOODPULP SHIPMENTS[1] BY MAJOR GRADES, 1979-89

(000 metric tons)

Year	Bleached sulfite	Unbleached sulfite	Bleached softwood sulfate	Bleached hardwood sulfate	Semi-bleached sulfate	Unbleached sulfate	Total chemical paper-grade	Mechanical	Dissolving & special alpha	Total woodpulp
1989	377	37	6,050	966	410	100	7,938	1,013	268	9,219
% change year ago	-10.5%	-21.3%	-5.1%	4.3%	-4.9%	-3.8%	-4.4%	26.8%	0.0%	-1.6%
1988	421	47	6,377	926	431	104	8,305	799	268	9,373
1987	437	48	6,317	911	474	119	8,306	676	243	9,226
1986	412	51	5,860	846	529	133	7,831	469	239	8,539
1985	329	52	5,357	819	506	158	7,221	384	216	7,821
1984	330	60	5,021	877	436	161	6,885	464	221	7,570
1983	296	61	5,332	745	418	191	7,043	317	209	7,569
1982	275	76	4,515	537	356	181	5,940	273	227	6,440
1981	387	105	4,979	602	485	226	6,784	284	271	7,339
1980	392	122	5,381	592	579	232	7,298	322	310	7,930
1979	406	111	5,096	558	531	264	6,966	109	371	7,446

1. Excluding pulp sent to integrated and affiliated mills inside Canada.
Source: Canadian Pulp & Paper Assn.

CANADIAN WOODPULP EXPORTS BY DESTINATION, 1979-89

(000 metric tons)

Year	U.S.	U.K.	Other Western Europe	Latin America	Japan	Other countries	Total
1989	3,688	384	2,010	129	1,298	833	8,342
% change year ago	-2.5%	-3.5%	6.0%	-18.9%	9.8%	-14.7%	-0.6%
1988	3,784	398	1,897	159	1,182	976	8,396
1987	3,649	394	1,809	205	1,129	1,055	8,241
1986	3,530	433	1,745	189	911	875	7,683
1985	3,408	321	1,483	155	789	852	7,008
1984	3,426	385	1,391	146	708	643	6,699
1983	3,289	272	1,594	101	744	795	6,795
1982	2,857	269	1,431	65	682	520	5,824
1981	3,250	326	1,667	96	692	568	6,599
1980	3,433	377	1,794	142	885	564	7,195
1979	3,577	408	1,606	86	689	416	6,782

Source: Canadian Pulp & Paper Assn.

Canada:

PRICES

Much of Canada's pulp and paper production is exported, and the industry's export products are customarily priced in U.S. dollars. That was to the advantage of Canadian mills in the early 1980s, due to the Canadian dollar's drop from approximate parity with the U.S. dollar in 1977 to below US75¢ in 1985. But the rising value of the dollar from 1986-on, and especially in 1989-90 to more than 85¢, cut into industry profits, especially since some companies rely on exports for 50% to 100% of of their income. This has occurred even though global competition in the pulp and paper business increased dramatically.

Therefore, the rise in the value of the Canadian dollar in 1987-90 meant that Canadian newsprint producers gained less from price increases than their counterparts in the U.S. Canadian sources provide 58% of U.S. newsprint consumption. The stronger dollar and weaker newsprint pricing combined to push down profits of Canadian pulp and papermakers 31.6% in 1989, compared with 1988. That trend continued into 1990, with first-quarter profits off 69% from the first quarter of 1989, and second-quarter profits dropped 76% from the 1989 level.

Earlier in the 1980s, during the last downturn in newsprint markets, eastern Canadian mills made money on sales to the U.S. because of a favorable dollar differential. In fact, many of British Columbia's mills might not have remained in business through this downturn without the weak Canadian dollar. It will be more difficult for the Canadian industry as currencies swing the other way and as competition for newsprint customers intensifies due to large amounts of capacity coming online from 1989 through the early 1990s.

EXPORT GRADES STRONGEST

Canadian producers saw weak pulp pricing during the first half of the 1980s, but the market swooped upward from 1986 through 1988, helping them achieve record prosperity in 1989. Bleached kraft export prices rose an average of 8.4% annually from 1976 to 1980, but during the 1981-85 period, prices declined 0.1%/year, or 10.2% for the five-year period. Bleached sulfite and unbleached kraft were hit just as hard. After dropping 15% in 1985, however, bleached sulfate pulp export prices jumped 13% in 1986, 25% in 1987, and an estimated 20% in 1988.

A weaker currency meant Canadian producers were not hit as hard as their U.S. counterparts during the down years. Between 1977 and 1986, the price of northern bleached softwood kraft (NBSK) in U.S. dollars rose about 25% in northern Europe and 22% in the U.S. The increase in Canadian dollars was 66% in Europe and 62% in the U.S. As the U.S. dollar began to weaken in 1985, Canadian currency dropped as well, maintaining the country's cushion. In the last quarter of 1986, the Canadian dollar bottomed out against the U.S. dollar at US72¢. The differential narrowed to 76¢ by the end of 1987, topped the 80¢ mark in the first quarter of 1988, and continued moving upward to 85¢ by 1990.

In the second quarter of 1980, the price of Canadian NBSK pulp exported to Europe hit a previous all-time high of US$545/metric ton, c.i.f. northern Europe. In the first quarter of 1982, producers attempted to raise the benchmark price by $35. Not only did they fail, but the soon-evident worldwide recession drove pricing backward. By August 1982, list quotes were down to the late-1979 level of $465—only $30 above the previous peak achieved in early 1975. By the first quarter of 1983, they had fallen still further to just $410, with spot-market quotes below that readily available.

A shutdown of most British Columbian mills caused by a labor dispute firmed up markets in early 1984, sparking a price recovery to US$540/ton for NBSK in Europe. But overcapacity and the very strong U.S. dollar combined to again knock down market pulp prices. By the end of 1984, NBSK sold in northern Europe for around $470 to $480, and prices plummeted to the $390 level in early 1985.

Producers pushed through four consecutive quarterly price hikes in 1986—bringing NBSK back to $520/ton—after the U.S. dollar weakened and markets strengthened in late 1985. The declining U.S. dollar against other major worldwide currencies benefited U.S. and Canadian producers alike, reversing the cost advantage of Scandinavian competitors and making price increases easy for overseas customers to absorb.

More increases followed in 1986: pulp prices rose in each of the eight quarters of 1987 and 1988 and in the first quarter of 1989. These hikes raised NBSK in Europe to US$810/ton by early 1989, a record high. The increase was held to $800 in the U.S. Because the U.S. dollar had strengthened against other major global currencies, the $10/ton difference between U.S. and European prices in 1989 was narrower than a $25/ton gap reflected in 1988 prices.

However, by fourth-quarter 1989, discounts of $15 to $30/ton were reported on low-end grades, with minor discounting on NBSK. By the end of first-quarter 1990, NBSK pricing stood at $830/ton with some discounting. That pricing level pretty much continued through the second quarter, but by the third quarter of 1990, the price had dropped $30. During that time, Canadian producers took extended maintenance downtime.

NEWSPRINT

Unlike pulp, newsprint prices stayed stronger during the early 1980s. Export prices climbed an average of 6.7%/year between 1981 and 1985, with only one year of decline in 1982. That performance was still down compared with the late 1970s, when prices climbed an average of 11.9%/year.

Canadian mills selling newsprint in the U.S. for US$500/metric ton tried raising their prices $25/ton in March, April, and June of 1982. Each time, a sizable group of small and large producers undercut the leaders' price hikes, preferring to maintain operating rates rather than support the increase.

Mills were still trying to raise prices in the fourth quarter of 1982 when widespread discounting forced them to reverse direction and actually cut list prices to $468.50/ton. It was not until third-quarter 1983 that they got the list back up to the previous level east of the Rockies. (Starting in July 1982, western producers offered contract customers 5% discounts from list price levels.) Prices did not finally break the $500/ton level until July 1984, when eastern mills went up to $535; however, discounting of this price continued through the year and into 1985.

Producers failed to raise prices seven times in 1985, as soft demand continued and imports of cheap offshore paper increased. Gradually improving demand in 1986 finally firmed up markets to allow a price hike in October, bringing the list price to $570/ton. However, most tonnage was still sold in the $530 to $550 range, and the increase was not implemented fully until early 1987. Markets remained strong in 1987, and producers were able to increase prices on July 1 and again on Jan. 1, 1988. The July 1987 increase brought the list price up to $610/ton in the eastern U.S., and the January 1988 hike boosted it to $650. Meanwhile, transaction prices continued significantly below list, in the range of $570 to $610/ton through most of 1988. By the year's final quarter, transaction rates began to erode significantly, and this continued into the next year. By June 1989, market prices had plunged to a new trough of $575/ton in the eastern U.S. and $560/ton in the western U.S. In the first quarter of 1990, transaction pricing on newsprint in the east was at $535/ton, off the $650 list. A price increase was implemented in June, bringing list to $685, but transactions stayed at about $120 off list.

During the 1980s, Canadian newsprint exporters were well served by the weak Canadian dollar, which shielded them from the worst of the price weakness at the beginning of the decade, making the subsequent price recovery all the more profitable. While newsprint prices in the U.S. market rose about 59% in U.S.-dollar terms between 1977 and 1986, the increase was 111% in Canadian dollars. Conversely, as the Canadian dollar climbed in 1987-89, Canadian producers saw their profits fall. In 1989, earnings fell again, primarily due to the 5¢ drop in the U.S. dollar during that time.

DOMESTIC PRICING

Historically, Canadian prices have not risen as rapidly for products intended for domestic use as they have for major export commodities. That was not true of the 1976-85 period, however. Among export grades, only newsprint rose faster than domestic prices for printing/writing papers and containerboard. Domestic containerboard prices rose an average of 7.9%/year during the 1976-85 period, compared with 9.3% for exported newsprint and only 5.3% for bleached kraft pulp exports. Fine paper prices in the domestic market rose an average of 5.7% annually during the same period.

This trend did not continue in the second half of the 1980s. With the steep rise in prices for woodpulp—a major export commodity—the momentum of domestic prices lost considerable ground. In 1987, the latest year for which price-index statistics are available, domestic prices for fine papers rose 7.0%, containerboard prices climbed 8.5%, and pulp export prices jumped more than 24%. However, the rise in offshore newsprint prices was just 5.0% in 1987.

Canadian prices generally track U.S. pricing activity, but Canadian mills enjoy a comfortable dominance of their domestic markets in the whole range of pulp, paper, and board products, and that helps them to maintain adequate pricing. For example, in 1987, the major imported pulp and paper commodity was printing/writing papers, amounting to 334,000 metric tons (about 30% of apparent domestic consumption). The second-biggest category was imported wrapping papers at 44,000 tons.

When U.S. prices for printing/writing papers were near their cyclical peak in early 1981, and when coated No. 3 printing paper (60-lb rolls) went for $897/short ton in the U.S., Canadian buyers by one estimate paid the equivalent of $1,070. Also at that time, Canadian consumers paid an estimated $30/short ton more for their 50-lb multiwall kraft sack paper than the $405 price in the U.S.

The price index for domestic writing and reproduction papers in Canada rose 83% between 1976 and 1987. Over the same period, the offset uncoated book paper price index in the U.S. rose 53%. The disparity was much higher in containerboard, where Canadian prices climbed 110% during the 1976-87 period, compared with 58% for kraft linerboard in the U.S. Canadian mills have traditionally found it easier to pass along price increases to converters. Now that the Canadian currency has strengthened relative to the U.S. dollar, it could weaken the position of some Canadian mills in their domestic markets. U.S. producers will find it easier to compete in Canada because of currencies and a new trade agreement between the two countries that will eliminate tariffs by 1993.

Trade barriers were also one reason for the price disparity. Domestic producers were protected in the past by relatively high tariffs of approximately 15% on a range of grades. However, a staged reduction from 1980 to 1987 reduced those barriers by more than half in most cases.

In 1987, the U.S. and Canada negotiated a trade agreement to remove the remaining barriers and to open both markets to free competition. This was expected to benefit the U.S. paper industry by adding an estimated $85.9 million in export dollar volume by 1999, according to the New York State Dept. of Economic Development. Canadian pulp and paper mills, however, were not expected to reap much of an advantage. Rather, Canada's major export growth potential was in offshore trade, particularly with Pacific Rim countries.

PRICE INDEXES FOR SELECTED COMMODITIES

(1981=100)

Year	Fine paper—writing and reproduction (domestic)	Containerboard (domestic)	Bleached sulfite pulp (export)	Bleached sulfate pulp (export)	Unbleached sulfate pulp (export)	Newsprint (export)
1988	150.2	162.2	138.3	143.0	143.0	138.3
1987	143.6	148.9	119.2	122.4	122.5	129.2
1986	136.4	137.2	95.6	98.2	98.1	123.0
1985	129.9	135.3	83.7	87.3	86.9	119.7
1984	126.5	128.9	97.1	102.3	102.2	109.6
1983	116.4	119.3	79.7	80.9	80.6	98.7
1982	112.2	112.1	92.4	93.6	93.5	104.7
1981	100.0	100.0	100.0	100.0	100.0	100.0
1980*	219.0	238.5	342.1	341.0	379.0	300.2
1979*	197.7	200.2	279.4	278.9	303.0	268.0
1978*	173.6	171.7	210.2	213.1	216.0	236.4
1977*	165.0	166.7	220.8	233.1	221.0	210.4
1976*	161.6	162.5	218.8	230.6	226.9	177.6
Average annual change						
1981-88	6.3%	7.8%	4.8%	5.4%	5.4%	4.8%
1976-80	6.3	9.4	8.8	8.4	11.3	11.9

* Base year for 1976-80 data is 1971.
Source: *Statistics Canada.*

Canada:

PROFITABILITY

The entire North American paper and forest products industry entered a downturn in 1989, but the Canadian industry especially suffered a headlong fall, with profits down 34% compared with the year earlier. A *Pulp & Paper Week* survey of 19 Canadian companies showed 1989 earnings of C$1.3 billion, with sales of $25.2 billion, up a slight 2.1% from 1988. Any gains accomplished during the year were wiped out by a devastating fourth-quarter performance, with industry earnings plummeting by about 65% compared with the same period in 1988. That followed a 37% dive in the third quarter.

Many of the same market conditions affected the North American industry on both sides of the border, but companies in the provinces continued to suffer from the growing value of the Canadian dollar in relation to foreign exchanges. Compared with the U.S. dollar, Canadian currency was about 4% stronger in 1989 than the year earlier, averaging approximately US$0.85 compared with $0.81 in 1988. Each one-cent annual change in the value of the Canadian dollar compared with its American counterpart results in a change in net earnings of about C$15 million. Additionally, Canadians have been experiencing considerably less leverage in pricing since 1987, when the Canadian dollar averaged 75¢ to the U.S. dollar. Other major culprits in the 1989 downturn were weak newsprint markets and higher wood costs in British Columbia.

Canadian producers on the West Coast suffered a bit less than their eastern counterparts, mainly because the pulp market remained firm through the year, at least for northern bleached softwood kraft (NBSK). But in 1989 and into 1990 that demand was partially inflated by downtime at several mills on the West Coast to control inventories. The industry was also bracing for continued difficult times, with pulp prices showing weakness early in 1990, looming expenses related to environmental improvements, and difficult labor negotiations involving 30,000 workers in the eastern provinces. Predictions that the rising Canadian dollar would finally begin to reverse appeared unfounded by the summer of 1990, but the industry took hope in a June 1 newsprint price hike and the market benefits from labor strikes at newsprint mills in Quebec, Ontario, and New Brunswick.

The most significant change on the industry landscape was Stone Container Corp.'s US$2.2-billion acquisition in March of Canadian giant Consolidated-Bathurst Inc., Stone's first major foray into newsprint production. The merger boosted Stone's 1989 sales, but the sinking newsprint market seriously cut into profitability.

Abitibi-Price Inc. suffered a 72% drop in profits to C$54 million on 1989 sales of $3.2 billion, down 1.4% from 1988. Included in the earnings report was a write-off of assets withdrawn or about to be withdrawn from production, plus related employee severance costs related to restructuring. Red ink flowed in the fourth quarter, with a net loss of $14 million. But before the $31.2 million charge before taxes, net earnings would have been $6.5 million in the fourth quarter, the company said. Newsprint sales in 1989 were down 7% from 1988, and declining transaction prices offset positive cost performance from the company's mills. Abitibi was the first to announce a price hike for newsprint early in 1990, although it was expecting the year to bring continued weak earnings for that grade and for groundwood papers.

Weak markets in white papers, paperboard, and packaging products were cited by Canadian Pacific Forest Products Ltd. for a 32% slide in profits to $323 million for 1989. CEO Cecil S. Flenniken said weakness in those markets and for newsprint were partially offset by continued strong demand in the pulp sector, with bleached kraft pulp experiencing a record year.

Despite deterioration in the fine paper and market pulp areas during the second half, Domtar Inc. said operating profits for these businesses improved. Citing firm pulp prices and increased coated paper shipments, Repap Enterprises Inc. reported a new high for revenues, up 34% for the fourth quarter and 19% for the year. MacMillan Bloedel Ltd. CEO Ray Smith called the company's 1989 earnings of $246.7 million "a good solid performance for the year."

The earnings reflect a strong pulp market and goods results from lumber and containerboard, the company said. Noranda Forest Inc. saw a 3.3% sales increase to $5 billion. Full-year profits would have been $45 million higher if the Canadian dollar and interest rates had remained at 1988 levels, the company said.

The Canadian dollar reduced Fletcher Challenge Canada Ltd.'s 1989 net earnings by over $25 million, the company said. The acquisition of the White Swan Division of E. B. Eddy Forest Products Ltd. by Scott Paper Ltd. contributed to a strong performance in 1989 for the tissue company.

OUTLOOK FOR 1990

The downturn that began in the second half of 1989 became a free-fall in the first quarter of 1990 as profits fell 69% to $124 million for 16 Canadian companies surveyed. Essentially, weak markets continued for newsprint, and the Canadian dollar wreaked havoc on exports and domestic market shares. But the new year also brought new concerns over reduced pulp shipments and softening paperboard packaging markets. Demand for market pulp waned as the second quarter got underway, but newsprint markets began to perk up as the June 1 price hike was instituted with early expectations of success.

The industry's after-tax profit margins narrowed to 2.1% in the first quarter of 1990, compared with 6.9% in first-quarter 1989. Sales remained at a virtual standstill, increasing a scant 0.7% to $5.9 billion. Abitibi's woes continued unabated in the first quarter, with losses totalling $11 million and interest expenses rising to $15 million from $10 million a year earlier. Despite the newsprint hike, the company expected earnings to remain below "acceptable levels" until capacity was reduced or further machine closures undertaken. Even an improvement in newsprint shipments late in the first quarter seemed only temporary, based on inventory building in anticipation of labor unrest and the looming price increase.

Canadian Pacific Forest Products also continued to take a beating on newsprint, reporting a 93% dive in first-quarter earnings compared with a year earlier. But the company was hinging its hopes on NBSK woodpulp, which makes up 90% of its pulp production. While pulp prices held in major markets for MacMillan Bloedel, volumes fell, especially due to extended maintenance downtime at its Harmac pulp mill in British Columbia. The Canadian dollar continued to climb in early 1990, adding more gloom to the industry's outlook.

The country as a whole also faced economic ramifications from the failure in June 1990 of the Meech Lake constitutional accord. Although initial speculation on the impending secession of Quebec from the federation was exaggerated, foreign investors were skeptical of the stability of the country's economy. The Ottawa government also wrestled with an unpopular goods and service tax of 7% that was scheduled to be implemented in January 1991.

Earnings in 1990 are also expected to be impacted by expensive environmental improvements undertaken by the industry to meet stricter regulations covering pollutants, dioxins, and furans. The Canadian Pulp & Paper Assn. estimated the cost to the industry would reach $5 billion in 1990. With financing seeming necessary to accomplish even essential projects, capital spending programs in Canada were also likely to be seriously curtailed in 1990.

CANADIAN PULP AND PAPER COMPANY SALES AND EARNINGS FOR 1989

(000 C$)

Companies	Sales	change % 1989/88	Earnings	change % 1989/88
Abitibi-Price[1]	3,257,700	-1.4%	54,200	-71.6%
Canadian Pacific	2,900,000	-3.3%	220,100	-31.9%
Canfor	921,200	-15.0%	96,400	-46.4%
Cascades	681,603	15.8%	29,887	-27.3%
Crestbrook	262,251	4.5%	32,137	4.4%
Doman[2]	485,753	60.6%	31,887	57.6%
Domtar[3]	2,515,000	0.6%	33,000	-70.3%
Donohue	641,472	-1.1%	44,250	-35.6%
Fletcher Challenge[4]	1,470,000	5.0%	96,200	-47.2%
MacMillan Bloedel	3,273,700	0.0%	246,700	-25.2%
Malette (9/30)	139,659	2.1%	18,571	17.1%
Noranda Forest	4,923,000	3.3%	189,000	-28.1%
Perkins Papers	71,713	13.2%	3,710	-18.3%
Repap	1,221,800	18.8%	93,100	0.3%
Rolland	438,380	-1.5%	-9,862	n.m.
Scott Paper Ltd.[5]	436,017	39.2%	17,969	10.6%
Tembec (9/30)	279,430	10.1%	34,214	26.5%
Weldwood	767,600	-14.2%	65,400	5.5%
West Fraser Timber	550,000	18.8%	28,400	-29.5%
Total	25,236,278	2.1%	1,325,263	-33.9%

n.m. = Not meaningful.

[1] 1989 income includes a $31.2-million pretax charge from restructuring.

[2] 1989 results include results from Western Forest Products Ltd. and Western Pulp Ltd. Partnership from July 1.

[3] 1988 results restated to reflect discontinued operations.

[4] 1989 income includes restructuring costs and write-down of investments in its Grande Cache, Alta., sawmill, offset by a gain on the sale of Western Forest Products.

[5] 1989 figures include results from the White Swan Div. of E. B. Eddy Forest Products, acquired in March.

Canada:

CAPACITY EXPANSION

Growth plans have been above-normal in the Canadian industry since 1986, when companies began to recover in earnest from the hard times of the early 1980s. Most of the growth, however, was in the smaller, nontraditional grades—higher-value printing/writing paper or mechanical market pulp—which require less capital than chemical grades. Canada's bread-and-butter export grades, newsprint and bleached kraft market pulp, experienced little or no growth.

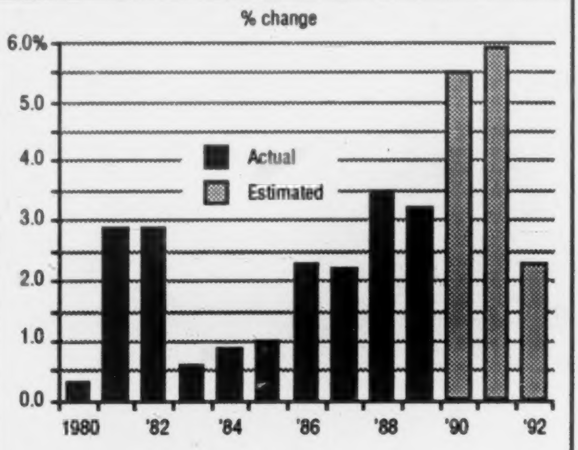
This situation turned around dramatically in 1988, when suddenly every major producer seemed ready to add newsprint capacity. Plans for new machines skyrocketed, and over the 1989-92 period, newsprint capacity will climb at the highest rate in several decades. Kraft pulp expansion plans also began to pick up in 1988, with a major push from Japanese companies announcing new mills for western Canada. Some forward integration into white papers will depress growth somewhat in bleached softwood kraft market pulp capacity, but even so, chemical paper-grade market pulp capacity will climb at twice the historical rate over the 1989-92 period. Mechanical market pulp capacity is also growing rapidly, thanks to the development of markets for bleached chemi-thermomechanical pulp.

Business conditions began to sour in 1989, and while the expansion boom continued to take shape, some producers began to delay or cancel expansion plans. Newsprint markets weakened first, and the pulp export market soon followed. In 1990, the industry found itself in the middle of a capacity expansion boom in its major grade segments just as markets had turned down dramatically. Capital spending plans have plunged, and the three-year outlook for capacity expansion is down 20% from this time last year. Because those original expansion plans were so ambitious, however, the overall growth pattern will still be above average through 1992, despite the cutbacks.

According to the 1989-92 Canadian Pulp & Paper Assn. capacity survey, completed in early 1990, growth will be over twice as strong in the 1989-92 period as in the preceding ten years. Growth will average 4.73%/year for paper and board, compared with 2.10% over the 1979-89 period. Market pulp capacity will grow an average 4.50% annually through 1992, up from 2.18%/year over the past ten years.

Total Canadian paper and paperboard capacity (excluding building and construction board) will climb from 17.6 million metric tons in 1989 to 20.2 million tons in 1992, an increase of 14.8%, CPPA reported. Total pulp capacity will climb 12.5% over the same period, from 25.7 million tons in 1989 to 28.9 million tons in 1992. Market pulp capacity, which accounts for over one-third of total pulp capacity, will rise 14.0% from 8.8 million tons in 1989 to 10.1 million tons in 1992.

PAPER AND PAPERBOARD CAPACITY GROWTH



Source: Canadian Pulp & Paper Assn.

CANADIAN INDUSTRY CAPACITY

(000 metric tons)

MARKET PULP

		Sulfate paper grades									
Year	Sulfite paper grades	Total	Bleached soft-wood	Semi-bleached softwood	Bleached hard-wood	Un-bleached	Total chemical paper grades	Dissolving & special alpha	Mechan-ical	Total market pulp capacity	% increase from previous year
1992e	341	7,860	6,069	329	1,360	102	8,201	250	1,600	10,051	2.7%
1991e	348	7,723	5,995	341	1,285	102	8,071	250	1,470	9,791	8.5
1990e	350	7,297	5,810	321	1,064	102	7,647	257	1,116	9,020	2.3
1989	343	7,103	5,714	316	969	104	7,446	281	1,090	8,817	4.8
1988	323	7,067	5,665	376	913	113	7,390	277	745	8,412	2.8
1987	331	7,004	5,533	473	873	125	7,335	245	599	8,179	2.4
1986	316	6,835	5,396	501	809	129	7,151	245	589	7,985	6.4
1985	305	6,624	5,233	420	794	177	6,929	266	574	7,769	1.3
1984	279	6,606	5,134	405	869	198	6,885	264	521	7,670	0.1
1983	322	6,571	5,130	453	780	208	6,893	267	500	7,660	0.6
1982	369	6,471	5,128	438	669	236	6,840	305	472	7,617	2.5
1981	397	6,413	5,056	433	634	290	6,810	303	317	7,430	2.7
1980	360	6,330	4,905	550	605	270	6,690	307	240	7,237	1.8

PAPER AND BOARD

Year	News-print[1]	Un-coated mechanical	Un-coated woodfree	Kraft papers	Tissue sanitary, special[2]	Con-tainer-board	Box-board	Total (excluding building, other)	Building, other[3]	Total paper/board capacity	% increase from previous year
1992e	10,900	2,319	1,622	539	730	2,346	964	20,225	728	20,953	2.3%
1991e	10,600	2,268	1,612	541	712	2,328	944	19,755	728	20,483	5.9
1990e	10,070	2,031	1,535	531	664	2,235	862	18,608	725	19,333	5.5
1989	10,020	1,843	1,316	512	572	2,056	795	17,614	716	18,330	3.2
1988	9,945	1,668	1,046	560	561	2,039	767	17,061	706	17.767	3.5
1987	9,855	1,407	931	579	521	1,965	773	16,501	666	17,167	2.2
1986	9,800	1,347	892	579	509	1,901	775	16,158	646	16,804	2.3
1985	9,725	1,135	898	541	502	1,869	798	15,783	649	16,432	1.0
1984	9,710	1,020	1,126	531	503	1,849	798	15,537	740	16,277	0.9
1983	9,885	875	1,026	554	486	1,794	767	15,387	751	16,138	0.6
1982	9,920	765	1,008	527	492	1,799	758	15,269	767	16,036	2.9
1981	9,490	660	1,019	566	467	1,884	792	14,878	711	15,589	2.9
1980	9,130	660	982	562	437	1,818	807	14,396	750	15,146	0.3

e = Estimate.

1. Figures have not been adjusted for changes in grammage of newsprint, and they are not directly comparable year to year.
2. Includes glassine and greaseproof papers.
3. Includes wet machine board.

Source: Canadian Pulp and Paper Assn.

Note: In its 1989 report on capacity expansion plans, CPPA replaced two old categories of printing/writing papers with four new categories. "Uncoated mechanical" replaces "Groundwood Printing & Specialty" with no change in data. "Uncoated woodfree" replaces "Book, Fine & Misc. Fine," but data are the same only through 1984. CPPA also added two categories of coated paper with data back to 1985:

Year	Coated mechanical	Coated woodfree
1992e	615	190
1991e	585	165
1990e	530	150
1989	380	120
1988	345	130
1987	330	140
1986	215	140
1985	175	140

MARKET PULP

Canada is the world's largest producer of paper-grade market pulp, with 28% of total world capacity in 1989, according to CPPA. About 90% of the country's market pulp is exported, since most Canadian paper mills are integrated. British Columbia accounts for almost 51.6% of capacity, most of it bleached softwood kraft, followed by Quebec with 15.6%, Ontario with 13.9%, and New Brunswick with 10.0%.

The market pulp sector is in the midst of an expansion boom fueled by strong profits during the final years of the 1980s and an influx of investment money from overseas, particularly Japan. Market conditions have subsequently deteriorated, but market pulp producers were sticking to their ambitious expansion plans when CPPA conducted its survey at the beginning of 1990. Although the numbers show very strong growth ahead, some companies have been cutting back on expansion plans, and it is likely that the actual tonnage added will be less than CPPA's report indicates. Expansion activity is still strong enough, however, to keep growth well above the ten-year average over the next three years.

Market pulp producers reported plans to add 1.23 million tons of new capacity from 1989 through 1992, raising overall capacity 14.0% to 10.05 million tpy. That averages out to a 4.5% annual increase, well above the 2.2% rate of the previous ten years. Kraft pulp accounts for about 60% of the increase, and mechanical pulp the remaining 40%. The high proportion of mechanical pulp expansion will raise its share of total market pulp capacity from 12.4% in 1989 to 15.9% in 1992.

Kraft market pulp capacity will climb to 7.86 million tpy by 1992, according to CPPA, an increase of 757,000 tpy, or 10.7%, over 1989 capacity of 7.10 million tons (this total does not include Alberta-Pacific Forest Industries Inc.'s proposal to build a 500,000-tpy mill in Athabasca, Alta.). The high point of the boom appears to be 1991, when 426,000 tpy of new capacity will be added for a one-year increase of 5.8%.

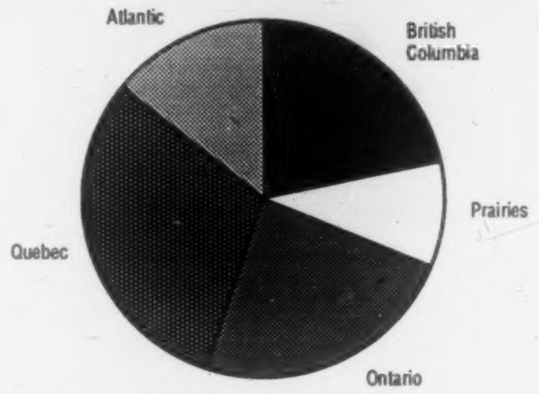
Bleached softwood kraft pulp capacity is expected to climb 355,000 tpy by 1992 to 6.07 million tons, a gain of 6.2% over 1989. Two major projects were slated for completion in 1990 at existing mills: Howe Sound Pulp & Paper Co. Ltd.'s 350-tpd expansion at Port Mellon, B.C., and Weldwood of Canada Ltd.'s 215,000-tpy doubling of capacity at Hinton, Alta. In addition, Daishowa Canada Co. Ltd. brought online its new 340,000-tpy mill in Peace River, Alta., in the fall of 1990.

In late 1991, Fletcher Challenge Canada Ltd. and James River-Marathon Ltd. are scheduled to complete major improvement programs adding 75,000 tpy and 178,500 tpy, respectively. A 235,000-tpy expansion program at Stone-Consolidated Inc.'s Castlegar, B.C., mill is targeted for completion in mid-1992.

Bleached hardwood kraft pulp capacity will jump 391,000 tpy by 1992 to 1.36 million tons, a substantial 40.4% increase over 1989, according to CPPA. Most of the extra capacity will result from three sources: Daishowa Canada's new Peace River mill; James Maclaren Industries Inc.'s 75,000-tpy expansion at Thurso, Que., in 1990; and Malette Inc.'s 1990-92 modernization program at Smooth Rock Falls, Ont., adding about 70,000 tpy of softwood and hardwood kraft output.

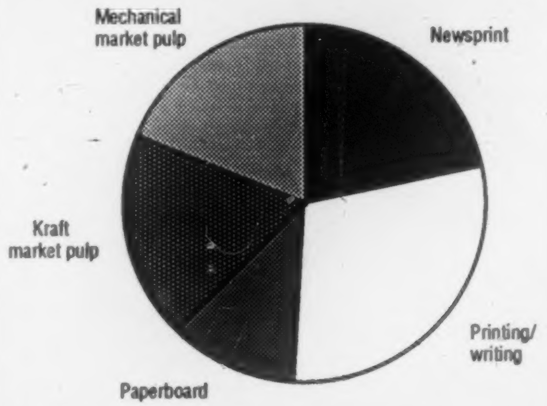
Mechanical market pulp has been one of the fastest growing sectors in Canada, but because of depressed markets, it is unclear exactly how much of the announced new capacity will actually be built. Most observers report that mills are holding back until conditions improve. Even with a slowdown in new plans, however, capacity growth

CAPACITY EXPANSION PLANS BY REGION, 1990-92



Source: Canadian Pulp & Paper Assn.

CAPACITY EXPANSION PLANS BY GRADE, 1990-92



Sources: Canadian Pulp & Paper Assn., *Pulp & Paper Project Report.*

NEW MILLS AND PAPER MACHINES ANNOUNCED FOR CANADA

Company	Location	Project	Grade	Capacity (metric tpy)
Started up in 1987				
CIP	Gatineau, Que.	New machine	Newsprint	175,000
Domtar	Windsor, Que.	New machine	Uncoated free-sheet	175,000*
Donohue	Clermont, Que.	New machine	Newsprint	180,000
Started up in 1988				
Consolidated-Bathurst	Bathurst, N.B.	New machine	Corrugating medium	150,000*
Fibreco Export	Taylor, B.C.	New mill	Bleached CTMP	180,000
Millar Western	Whitecourt, Alta.	New mill	Bleached CTMP	210,000
St. Marys Paper	Sault Ste. Marie, Ont.	New machine	SC groundwood	118,000
Weyerhaeuser Canada	Prince Albert, Sask.	New machine	Uncoated free-sheet	220,000
Started up in 1989				
Canadian Pacific Forest Products	Dryden, Ont.	New machine	Uncoated free-sheet	175,000
Canadian Pacific Forest Products	Gold River, B.C.	New mill	Newsprint	225,000
Cascades	Kingsey Falls, Que.	New machine	Tissue	25,000
Domtar	Windsor, Que.	New machine	Uncoated free-sheet	175,000*
Finlay Forest Industries	Mackenzie, B.C.	New machine	Newsprint	216,000
Irving Pulp & Paper	St. John, N.B.	New machine	Tissue	60,000
Repap Enterprises	Newcastle, N.B.	New machine	Coated paper	260,000
Tembec	Temiscaming, Que.	New machine	Bleached paperboard	110,000
Vicell Canada Tissue	Delta, B.C.	New mill	Tissue	9,000
For startup in 1990				
Alberta Energy	Slave Lake, Alta.	New mill	Bleached CTMP	110,000
Alberta Newsprint	Whitecourt, Alta.	New mill	Newsprint	220,000
Atlantic Packaging	Whitby, Ont.	New mill	Tissue/newsprint	185,000
Canadian Pacific Forest Products	Thunder Bay, Ont.	New machine	Newsprint	240,000*
Daishowa Canada	Peace River, Alta.	New mill	Bleached kraft pulp	340,000
Donohue	Matane, Que.	New mill	Bleached CTMP	190,000
Stone-Consolidated	Grand'Mère, Que.	New machine	Groundwood specialties	183,000*
Tembec	Temiscaming, Que.	New machine	Bleached paperboard	110,000
For startup in 1991				
Consumers Paper	Redcliff, Alta.	New mill	Tissue	25,000
Howe Sound Pulp & Paper	Port Mellon, B.C.	New mill	Newsprint	192,500
Kruger	Trois Rivières, Que.	New machine	Newsprint	180,000*
Louisiana-Pacific	Chetwynd, B.C.	New mill	Bleached CTMP	157,500
Perkins Papers	Candiac, Que.	New machine	Tissue	50,000
For startup in 1992				
Interchem Industries	Port Clement, B.C.	New mill	Sulfite pulp	35,500
Millar Western	Meadow Lake, Sask.	New mill	Bleached CTMP	240,000
Proposed (no startup date announced)				
Alberta-Pacific Forest	Athabasca, Alta.	New mill	Bleached kraft pulp	496,000
Fibreco Export	Taylor, B.C.	New mill	Bleached CTMP	180,000
Nortek Forest Products	Nipawin, Sask.	New mill	Mechanical pulp	110,000
Orenda Forest Products	Stewart, B.C.	New mill	Bleached CPGW	108,500
Repap Enterprises	The Pas, Man.	new mill	Bleached kraft pulp	428,500
Shin Ho Canada	Thunder Bay, Ont.	New mill	Bleached CTMP	150,000
Stake Technology	Rimouski, Que.	new mill	Mechanical pulp	100,000
Takema Forest	Fort Nelson, B.C.	New mill	Bleached CTMP	190,000

*Replaces some existing capacity.

through 1992 will remain strong due to projects already under way or recently completed.

Four new bleached chemi-thermomechanical market pulp lines started up in the 1988-89 period, and three more greenfield mills are under construction for completion from 1990 to 1992. As a result, the industry expects to add 510,000 tpy to mechanical pulp capacity by 1992, a 46.8% increase to 1.6 million tons overall. This huge increase will come on the heels of 491,000 tons of new capacity added in 1988 and 1989. All told, the boom that started in 1988 will almost triple capacity from the relatively stable 500,000- to 600,000-tpy level of the mid-1980s.

Donohue-Matane Inc. and Slave Lake Pulp Corp. are scheduled to complete new bleached CTMP mills in late 1990. The Donohue mill in Matane, Que., will have capacity for 190,000 tpy, while the Slave Lake, Alta., mill will produce 110,000 tpy. In first-quarter 1991, Louisiana-Pacific Corp. plans to complete its new 157,500-tpy bleached CTMP plant in Chetwynd, B.C.

PAPER AND PAPERBOARD

Canada's largest grade sector, newsprint, is in the midst of an expansion boom marking the first period of strong growth since 1981-82. Capacity will rise from 10.02 million tons in 1989 to 10.9 million tons in 1992, an increase of 880,000 tpy, or 8.8%. Capacity will rise an average of 2.9% a year through 1992, compared with average growth of just 1.0% annually during the 1980s.

After a 50,000-tpy increase in 1990, newsprint capacity will jump 530,000 tpy next year, mostly on the strength of five new paper machines scheduled to come online in 1990 and 1991. A 300,000-tpy increase is slated for 1992.

The newsprint expansion boom began in earnest in 1989 when work on two new machines was completed. Early in the year, Finlay Forest Industries Ltd. integrated its refiner mechanical market pulp mill in Mackenzie, B.C., with a new 600-tpd newsprint machine. In late 1989, Gold River Newsprint Co. started up in Gold River, B.C., with capacity for 230,000 tpy on one machine.

Alberta Newsprint Co. Ltd. started up its new 220,000-tpy newsprint mill at Whitecourt, Alta., in fall 1990, and Atlantic Packaging Products Ltd. plans to bring a new 150,000-tpy machine online in late 1990 or early 1991. Canadian Pacific Forest Products Ltd. and Kruger Inc. also plan to start up new machines in late 1990/early 1991. CPFP's new 240,000-tpy No. 5 machine at Thunder Bay, Ont., will replace two older units for a 60,000-tpy net increase in capacity. Kruger's new machine at Trois Rivières, Que., will have capacity for 180,000 tpy, but about 70,000 tpy of the increase will be offset by conversion of No. 4 machine at Corner Brook, Nfld., to produce supercalendered paper.

The final machine to come online in this round of expansions will be at Howe Sound Pulp & Paper Co. Ltd.'s new 535-tpd mill at Port Mellon, B.C., scheduled for startup in July 1991.

The current expansion boom was originally expected to be much larger than it has turned out to be, although it is still larger than any growth period since the 1970s. Collapsing prices put the squeeze on newsprint companies in 1989, resulting in a series of project cancellations, postponements, shutdowns of high-cost capacity, and conversions to other grades. By late 1989, companies had revised their newsprint expansion plans down substantially from earlier estimates.

As a result, capacity climbed just 75,000 tpy in 1989, instead of the 265,000 tpy envisioned earlier. The forecast for 1990 plunged from 685,000 tpy of new capacity to just 50,000 tpy, mostly due to postponements of new machine installations to late in the year or early in 1991. All told, the three-year outlook for newsprint expansion has dropped from 1.48 million tpy a year ago to 880,000 tpy in 1990—a cutback of 41%.

Other paper grades. Capacity for printing/writing papers will jump 29.7% to 4.75 million tons by 1992, according to CPPA. Growth will average 9.2%/year through 1992 compared with 8.8% annual growth over the 1979-89 period. The biggest increases are planned for coated mechanical papers, which will rise 61.8% to 615,000 tons by 1992, due primarily to the 1989 startup of a new machine at Repap Enterprises Inc.'s Newcastle, N.B., mill.

Three new paper machines will raise uncoated free-sheet capacity 23.3% to 1.62 million tons by 1992. In 1988, Weyerhaeuser Canada Ltd. integrated its Prince Albert, Sask., market pulp mill with a new 220,000-tpy machine. In second-quarter 1989, Domtar Inc. brought onstream another new machine at Windsor, Que.; the first new machine came online in 1987. The mill now has capacity for 320,000 tpy. Also in second-quarter 1989, CPFP started up its new 175,000-tpy paper machine at Dryden, Ont.

A new coating facility installed at Island Paper Mills Co.'s New Westminster, B.C., mill in 1989 is responsible for much of Canada's projected 58.3% jump in coated free-sheet capacity to 190,000 tons by 1992.

Uncoated mechanical paper capacity is expected to grow by 25.8% to 2.32 million tons during the 1989-92 period. Stone Consolidated installed a new 183,000-tpy groundwood specialties machine at Grand'Mère, Que., in mid 1990, while Kruger and Fletcher Challenge Canada have converted newsprint capacity to groundwood papers.

Four new machines will raise sanitary papers capacity by 31.4% to 666,000 tons in 1992. Atlantic Packaging Products, Whitby, Ont., and Irving Tissue Ltd., Saint John, N.B., each added a new machine early this year, and a third machine was brought online in early 1990 at Cascades Inc.'s Kingsey Falls, Que., mill. In mid-1991, Perkins Paper Ltd. will start up a new tissue unit at Candiac, Que.

Containerboard capacity will climb 14.1% to 2.34 million tons by 1992. This is due primarily to an increase in kraft linerboard capacity at Eurocan Pulp & Paper Co.'s Kitimat, B.C., mill in 1989.

A healthy 21.3% jump in capacity is expected in the boxboard sector. Much of the growth comes from Tembec Inc.'s new bleached paperboard machine at Temiscaming, Que., started up in 1989.

Canada:

CAPITAL SPENDING

After three years of record increases, Canadian pulp and paper companies plan to cut back on capital spending in 1990. According to *Statistics Canada*, the industry intends to spend C$4.62 billion on capital projects in 1990, down 10.1% from outlays of $5.13 billion in 1989 (these totals exclude repair expenditures, which are expected to total $1.96 billion in 1990, up 4.8% from 1989. Spending for machinery and equipment is expected to total $4.04 billion this year, down 10.1% from 1989, while outlays for construction will drop 10.3% to $574 million.

Canadian pulp and paper companies enjoyed strong markets and record prices during the late 1980s, enabling them to spend heavily for modernization and expansion projects. If spending drops off as expected, it will end three years of double-digit increases.

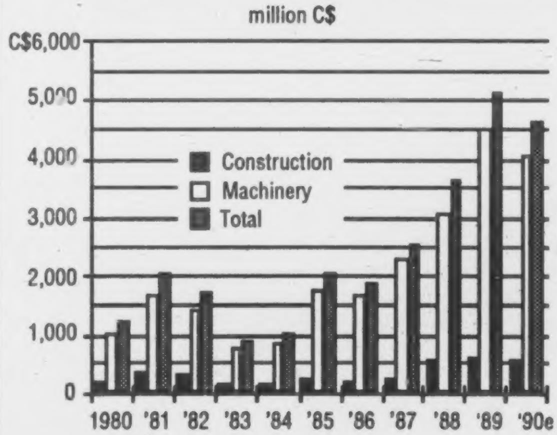
"Preliminary actual" figures for 1989 show an increase of 40.5% in capital expenditures, to $5.13 billion. This revised figure is down 8.3% from the spending intentions reported in the fall of 1989, however, suggesting that the decline in spending plans evident in 1990 was already under way in late 1989. The industry has been plagued by lower prices for newsprint, a strong currency, and deteriorating markets for pulp, leading to lower profitability and cutbacks in capital spending. More directly, spending plans have dropped because of environmental concerns about massive greenfield development plans in western Canada. Alberta-Pacific Forest Products Ltd.'s proposed $1-billion bleached kraft market pulp mill at Athabasca, Alta., is the best example. Originally slated for startup in 1991, the project is in danger of being canceled outright because of local concerns about the mill's impact on the environment.

ENVIRONMENTAL SPENDING STILL HIGH

While threatening new development, concerns about the environment will nevertheless fuel spending at existing mills over the next few years. The Canadian Pulp & Paper Assn. estimates that about 25% of capital expenditures in 1989 went for environmental programs. Spending for dioxin elimination, recycled-fiber facilities, and air emission improvements are expected to remain high for the next several years. CPPA estimates that the industry must spend approximately $3 billion a year to maintain and upgrade facilities to improve productivity and competitiveness. The additional need for environmental improvements should keep spending above this level. While markets remain weak, mills will cut back on expansion projects and concentrate their efforts in the environmental area.

Repap Enterprises Inc., for example, expects to cut its capital spending on all but environmental improvements,

CONSTRUCTION VS MACHINERY COSTS IN CANADIAN CAPITAL SPENDING



e = Estimate.
Source: *Statistics Canada*

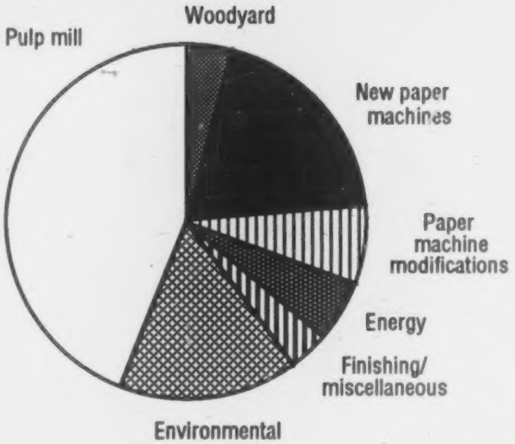
postponing new projects, chairman George Petty said at the company's annual meeting. After spending $2.3 billion in the past five years, the company will invest only $150 million in 1990 and $100 million in 1991 and 1992. Until last fall, Repap planned to spend $1.1 billion on a two-phase expansion and conversion of the Manfor mill in The Pas, Man.

Fletcher Challenge Canada Ltd. has reduced its 1990 capital spending budget to $279 million from a previously estimated $425 million in the face of weaker pulp markets and heavy costs associated with meeting environmental standards, Ian Donald, president and CEO, said after his company's annual meeting. "We're down to spending only on those projects that are needed to meet environmental standards," he noted. Other projects, such as the proposed debottlenecking of the company's Mackenzie, B.C., pulp mill, have been deferred. The Mackenzie program would have added 40,000 tpy of market pulp capacity.

Canfor Corp. expects to reduce capital spending from its previously budgeted C$160 million this year, chairman and CEO Peter Bentley said recently. Western Pulp Limited Partnership, recently acquired by Doman, plans to spend $70 million on environmental improvements over the next three years, but no other major capital projects are presently under consideration.

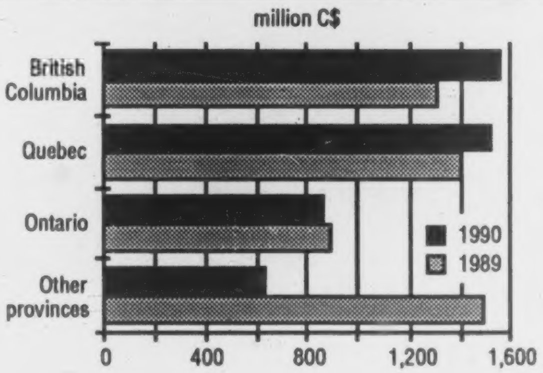
In eastern Canada, Abitibi-Price Inc. is preparing a new strategic plan. The company has not earmarked any more mills or machines for closure, but it will continue to concentrate on converting old mills to more specialized products. Environmental spending at Abitibi will also remain high. Estimated spending will total $150 million in 1990, down from $260 million last year.

ESTIMATED CAPITAL SPENDING BY PROCESS AREA, 1989-91+



Source: *Pulp & Paper Project Report.*

CANADIAN SPENDING BY PROVINCE



Source: *Statistics Canada.*

TOP SPENDERS IN CANADIAN INDUSTRY*

(000 C$)

Company	1989-91+
Abitibi-Price	198,000
Alberta Energy	168,000
Alberta Newsprint	360,000
Boise Cascade Canada	306,000
Bowater	128,000
Canadian Pacific Forest Products	1,088,900
Canfor*	320,000
ariboo Pulp & Paper*	131,100
Cascades*	188,540
Daishowa Forest Products	146,000
Daishowa Paper Manufacturing .	500,000
Domtar*	104,450
Donohue	319,265
E.B. Eddy Forest Products*	161,714
Eurocan Pulp & Paper	126,000
Finlay Forest Industries	165,000
Fletcher Challenge Canada	543,450
Howe Sound Pulp & Paper*	831,000
James River-Marathon	377,647
Kruger	479,500
Louisiana-Pacific	200,000
Maclaren Industries	168,500
MacMillan Bloedel*	406,000
Malette Kraft Pulp & Paper*	150,000
Procter & Gamble Cellulose*	330,000
Quebec & Ontario Paper*	357,800
Repap Enterprises*	589,200
Scott Paper*	147,760
Stone-Consolidated*	982,000
Tembec*	615,210
Weldwood of Canada.	362,500

*Includes programs for completion beyond three-year period indicated.
Note: All totals include production and environmental programs.

GEOGRAPHIC BREAKDOWN

During the past decade, the pattern of provincial expenditures has shifted in focus from western Canada to eastern Canada, and then back again. Until 1982, British Columbia and Alberta led the field in total dollar amounts, capacity expansion, and greenfield mill plans. After 1982, spending programs in Ontario and Quebec eclipsed the western provinces. Weak markets and high production costs dealt a heavy blow to British Columbian companies during the recession, while in Quebec and Ontario, federal aid designed to modernize the industry helped some eastern companies when the economy forced internal cutbacks. Recently, however, emphasis on capacity expansion has shifted the advantage back to resource-rich western Canada.

Heavy spending for environmental programs will boost capital outlays in British Columbia to $1.57 billion this year, an increase of 18.6% over 1989. Spending for machinery and equipment will rise 11.0% to $1.32 billion, while construction costs will climb 87.3% to $244 million. The increase planned for 1990 follows gains of 59.9% in 1989 and 74.2% in 1988.

In Quebec, companies report plans to spend $1.53 billion in 1990, up 8.4% from 1989 outlays of $1.41 billion. Outlays for construction will drop sharply to $167 million, down 25.0% from last year. Spending for machinery and equipment, on the other hand, is expected to climb 14.7%, to $1.37 billion.

As the chart on province-by-province spending shows, lower spending in the "other" provinces is largely responsible for the national downturn in spending plans. An expansion boom in the western and Maritime provinces fueled increases of 136.1% in 1988 and 23.1% in 1989, according to *Statistics Canada* data, driving spending to a record $1.50 billion in 1989. With new greenfield projects in Alberta and Manitoba delayed by environmental challenges and weaker markets, however, companies now report plans to spend just $647 million in the other provinces in 1990, down 56.9%—almost $853 million—from last year. The decline is evenly balanced between construction spending, which will drop 63.4% to $64 million, and outlays for machinery and equipment, which will fall 56.0% to $584 million.

Spending is also expected to decline this year in Ontario, falling 3.4% from $898 million last year to $868 million in 1990. Construction expenses are expected to total $100 million, down 12.4% from last year, while machinery and equipment spending will fall 2.1% to $768 million.

HISTORICAL PATTERN

The past ten years have been a roller coaster ride for capital spending in Canada. Canadian pulp and paper companies boosted capital expenditures dramatically during the late 1970s, when government assistance programs spurred outlays as the industry was gearing up for a heavy round of expansion. Total yearly outlays rose from C$607 million in 1978 to a peak of $2.05 billion in 1981, an increase of 238%. However, that situation reversed itself quickly in the back-to-back recessions of the early 1980s, when companies slashed expenditures on nonessential items. Spending in 1983 dipped to $903 million, down 48% from 1982 and down 56% from the 1981 peak.

The economic picture began to brighten during the second half of 1983, although more slowly in Canada than in the U.S., and by late 1984, capital spending plans were back on track at prerecession levels. Spending recovered modestly in 1984 to $1.01 billion, a gain of 12%, and exploded in 1985 back above the $2-billion mark.

The big increase in 1985 spending was somewhat surprising, considering that Canadian companies had not fully recovered from the recession. Low prices and increased offshore competition put the squeeze on profit margins during this period, and the industry was also still saddled with debt from the big spending increases of 1980 and 1981. A Pulp & Paper magazine survey in late 1985 found a 10% decrease in reported spending plans as many companies continued to defer spending programs. Nevertheless, capital outlays soared to $2.04 billion for the year, a 100% increase over the 1984 level.

The profit picture improved considerably in 1986, but capital spending slipped from the near-record 1985 pace to $1.89 billion, down 7% from the previous year. Statistics Canada figures show that producers spent about 13% less in 1986 than they originally planned. Spending climbed to a record $2.54 billion in 1987 on the strength of record earnings and accelerating expansion plans, a gain of 35%. The stock market crash of October 1987 added a temporary note of uncertainty to the outlook, but companies quickly resumed an aggressive posture, pushing spending up 44% to $3.65 billion in 1988.

While efforts during the middle of the past decade were focused on cost containment and productivity improvement, spending plans in the late 1980s were driven mainly

CAPITAL SPENDING PLANS OF MAJOR CANADIAN PAPER COMPANIES

(million C$)

	1990e	1989	% change
Abitibi-Price	150	260	-42.3%
Bowater Mersey	12	72	-83.3
Cariboo Pulp & Paper	27	44	-38.6
Domtar	250	322	-22.4
Canadian Pacific	500	480	4.2
Canfor	160	103	55.3
Fletcher Challenge	279	465	-40.0
Fraser	65	77	-15.6
Noranda Forest	700	812	-13.8
Quebec & Ontario	89	137	-35.0
Repap Enterprises	150	653	-77.0
Stone-Consolidated	191	237	-19.4
Total	2,573	3,662	-29.7

e = Estimate.
Source: *Pulp & Paper Project Report.*

by capacity expansion, particularly in newsprint, market pulp, and fine papers. In 1989, newsprint producers began a huge buildup in capacity that will last into 1991. Chemical market pulp producers geared up for a similar glut of new capacity, although some projects have since been delayed. Much of this pulp mill spending was funded by overseas interests, particularly the Japanese. More so than in the U.S., capital spending in Canada is getting a boost from overseas investment. Of ten major expansion programs announced in 1988, five of the largest involve major investments by overseas papermakers.

Entrepreneurial investment has also been a major factor in Canadian spending plans. Led by Repap, companies such as Cascades Inc. and St. Marys Paper Inc. that have rescued and rejuvenated old mills are responsible for a share of spending out of proportion to their size. Another group of entrepreneurs has come in from outside the industry and built new capacity, especially in the West. Fibreco Export Inc. in British Columbia and Millar Western Pulp Ltd. in Alberta brought online new chemi-thermomechanical market pulp mills in 1988, and Millar Western is building another mill for startup in 1992 in Saskatchewan.

SPENDING BY CATEGORY

In Pulp & Paper's fall 1989 survey of spending, Canadian companies reported plans to spend C$12.87 billion on capital projects during the 1989-91 period, up from $9.95 billion reported in 1989 for the 1988-90 period. Spending for production-related projects totals $10.82 billion for 1989-91, up 15% from the previous survey. Environmental spending plans rose a whopping 276.6%, climbing from $544 million in the 1988-90 survey to $2.05 billion for 1989-91. Environmental projects claimed a 15.9% share of overall spending, up threefold from the previous year.

Spending to control water pollution is up the most, climbing over 500% from $263 million in the 1988-90 period to $1.59 billion for 1989-91. Air quality projects show a 56.4% increase, totaling $386 million. Spending for solid waste disposal is up 105% to $70 million for the 1989-91 period.

Woodyard improvements show the highest percentage growth among production-related projects, rising 107.6% to $546 million. Spending in the power plant is up 43.8% to $727 million. Outlays for new paper machines declined by 21.3% in the new survey.

Pulp mill improvements account for over half of all production-related spending in the 1989-91 period. Pulp mill spending plans total $5.64 billion, up 35.0% from the 1988-90 survey. Paper machine rebuilds amount to just 9% of production spending, reflecting continued emphasis on new paper machine installations, which have a 23% share. Rebuild spending totals $974 million, up 4.7% from 1988-90.

New mills and paper machines focus on newsprint, tissue, and printing/writing grades, as well as on kraft and mechanical market pulp. Two new paper mills and seven new paper machines at existing facilities were started up in 1989.

PAPER AND ALLIED INDUSTRIES' CAPITAL AND REPAIR EXPENDITURES

(million C$)

Year	Capital spending: Construction	Capital spending: Machinery/ equipment	Capital spending: Total	Repair expenditures: Construction	Repair expenditures: Machinery/ equipment	Repair expenditures: Total
1990e	C$573.9	C$4,041.1	C$4,615.0	C$114.7	C$1,847.1	C$1,961.8
1989	639.6	4,493.9	5,133.5	118.7	1,752.8	1,871.5
1988	603.0	3,051.6	3,654.6	100.7	1,668.1	1,768.8
1987	255.5	2,286.5	2,542.0	92.2	1,514.7	1,606.9
1986	232.8	1,656.8	1,889.6	89.6	1,088.1	1,177.7
1985	263.5	1,772.1	2,035.6	83.1	1,051.7	1,134.8
1984	154.2	860.1	1,014.3	81.3	850.1	931.4
1983	140.9	762.2	903.1	66.5	751.5	818.0
1982	323.2	1,420.0	1,743.2	70.0	783.5	853.5
1981	375.6	1,676.0	2,051.6	71.5	761.6	833.1
1980	192.3	1,040.7	1,233.0	68.4	682.4	750.8
1979	77.8	685.3	763.1	59.2	604.0	663.2
1978	94.3	513.0	607.3	48.2	487.5	535.7
1977	168.9	521.3	690.2	35.1	445.7	480.8
1976	114.7	490.1	604.8	36.5	417.1	453.6
1975	87.0	399.9	486.9	24.1	315.0	339.1
1974	102.9	365.8	468.7	28.7	348.0	376.7
1973	77.1	264.8	341.9	17.5	264.3	281.8
1972	100.4	267.8	368.2	13.9	196.8	210.7
1971	128.3	377.9	506.2	11.6	207.0	218.6
1970	122.3	366.0	488.3	12.5	189.8	202.3
1969	97.1	228.6	325.7	11.5	177.0	188.5
1968	58.2	181.9	240.1	10.7	157.0	167.7
1967	99.0	319.5	418.5	10.6	158.1	168.7
1966	127.2	379.2	506.4	12.3	139.1	151.4
1965	102.2	281.6	383.8	12.9	118.5	131.4
1964	64.7	229.0	293.7	9.2	112.7	121.9
1963	36.4	145.2	181.6	11.0	96.8	107.8
1962	34.5	113.3	147.8	10.5	96.2	106.7
1961	33.1	105.3	138.4	7.7	92.6	100.3

Source: *Statistics Canada.*

Canada:

MERGERS AND ACQUISITIONS

Ever since the late 1970s, merger and acquisition activity in the Canadian pulp and paper industry has been largely cyclical, responding to the ups and downs of the general economic climate. For example, the years 1978-81 were hectic, with the most significant events during that period being the takeovers of Canada's two largest pulp and paper companies—MacMillan Bloedel Ltd. and Abitibi-Price Inc.—by outside interests.

The pendulum swung in the opposite direction as the recession of 1982 halted takeover activity. During the following two years, only three major ownership changes took place: Crown Zellerbach Corp. sold its Canadian operations to Fletcher Challenge Ltd. of New Zealand; Western Forest Products Ltd. sold its two British Columbian pulp mills to a limited partnership group; and Bowater Corp. of the U.K. spun off its North American assets into Bowater Inc.

Consolidating ownership. The pattern of smaller, more select purchases continued in 1985. Still not fully recovered from the overexpansion of the early 1980s, companies were cautious in their spending plans. Canfor Corp., CIP Inc., and Noranda Inc. all consolidated their holdings in 1985 by purchasing the remaining assets of companies in which they already held majority stakes. Meanwhile, Rauma-Repola Oy of Finland, a major supercalendered paper producer, bought 25% of St. Marys Paper Co. of Ontario as both an entrée into the North American marketplace and an avenue for possible future cooperative ventures.

The one major exception to the small-scale deals that took place during 1985 was Gulf Canada Ltd.'s purchase of 90% of the stock of Abitibi-Price from real estate developers Olympia & York Developments Ltd. Gulf's acquisition of Abitibi was accomplished in four installments over a period of four months. Its final share of Abitibi was diluted, however, when Abitibi issued additional common shares and common share purchase warrants in April 1986, bringing Gulf's ownership down to approximately 83.4%. Gulf further reduced its Abitibi interest in 1987 by spinning off its shares in a major reorganization of its total holdings, which increased the public float of Abitibi shares to 27%.

A bit of controversy accompanied the 1985 purchase of ITT Rayonier Inc.'s idle Port Cartier, Que., dissolving pulp mill by Cascades Inc. and Rexfor, the provincial forestry corporation. Plans to approve government funding of a mill conversion to chemi-thermomechanical pulp production were criticized by the Canadian Pulp and Paper Assn., which claimed that the government's assistance in the Port Cartier project was unfair to other Canadian producers.

The other major pulp mill purchase of 1985 proceeded uneventfully, as Repap Enterprises Inc. acquired Boise Cascade Canada Ltd.'s Newcastle, N.B., kraft pulp mill. The major significance of this deal was Repap's intention to construct a lightweight coated groundwood mill at the Newcastle site, using part of the pulp mill's output to provide some of the furnish needed for the new operation.

More mill sales. The level of acquisition activity in 1986 did not increase from that of the previous year, although the deals themselves were increasingly newsworthy. As the year progressed, the level of activity accelerated, with many deals reaching conclusions in 1987. In a joint venture of international scope announced in June 1986, a partnership was formed by Consolidated-Bathurst Inc., Power Corp. of Canada, and China International Trust & Investment Corp. (CITIC—the investment agency of People's Rep. China) to purchase Westar Timber Ltd.'s Castlegar, B.C., kraft market pulp mill. The deal was the first major investment made by CITIC, giving it a 50% share in the mill. The Canadian companies each acquired 25% shares.

Weyerhaeuser Canada Ltd., in a deal reminiscent of Repap's, bought Prince Albert Pulp Co. Ltd. and announced plans to build a new paper mill at the Saskatchewan site to produce uncoated free-sheet papers. Repap, meanwhile, further expanded its presence in the industry by purchasing Westar Timber's Prince Rupert, B.C., kraft market pulp mill. With the sales to Repap and the Con-Bath/PCC/CITIC partnership, Westar removed itself from the ranks of Canadian pulp producers.

Major sales in early 1987. The biggest deals during the first half of 1987, in terms of both money and publicity, were the sales of Donohue Inc. and British Columbia Forest Products.

In the fall of 1986, the Quebec government offered for sale its shares of both Donohue and Domtar Inc., drawing interest from a large variety of sources. A deal was finally struck in February 1987, when an offer for the Donohue shares, tendered by Quebecor Inc. and Maxwell Communications Inc. (formerly British Printing & Communication Corp.), was deemed acceptable by the Quebec government. The C$320-million deal for 55.25% of Donohue was completed in July. The Domtar shares, which appreciated greatly in value following the original offer to sell, failed to find a buyer and remained under Quebec's control.

Also in February 1987, Fletcher Challenge Ltd. of New Zealand made an offer for a 42% interest in BCFP, acquired the previous year by Gordon Investment Corp. and

MAJOR CANADIAN PAPER INDUSTRY ACQUISITIONS

Acquiring company	Assets purchased	Estimated value (million C$)	Year
Malette Inc., Rexfor	Formed joint venture to buy assets of St-Raymond Paper Inc.	n.a.	1990
Louisiana-Pacific Corp.	Increased stake in Doman Industries Ltd. to 14.7%	n.a.	1990
Stone Consolidated Inc.	Completed purchase of remaining CB Pak Inc. shares	C$47	1989
Mölnlycke AB	50% stake in Sancella Inc.	n.a.	1989
Stone Container Corp.	Consolidated-Bathurst Inc.	2,600	1989
Doman Industries Ltd.	Increased stake in Western Forest Products Ltd. to 56%	137	1989
Repap Enterprises Inc.	Manfor Ltd.	132	1989
Scott Paper Ltd.	E.B. Eddy Forest Products Ltd.'s White Swan Tissue Div.	110	1989
West Fraser Timber Ltd.	50% stake in Alberta Newsprint Co. Ltd.	n.a.	1989
Maclaren Industries Inc.	41% stake in Normick Perron Inc.	120	1989
Olympia & York	Raised stake in Abitibi to about 84% as of Nov. 1, 1989	n.a.	1989
Canadian Pacific Ltd.	Merged Great Lakes Forest Products Ltd. with CIP Inc. to form Canadian Pacific Forest Products Ltd.	1,260	1988
Daishowa Paper Manufacturing Co.	Peace River, Alta., greenfield mill	500	1988
Daishowa Paper Manufacturing Co.	Reed International plc's North American Paper Group	650+	1988
Fletcher Challenge Ltd.	Raised stake in BCFP to 67.4% and in Crown Forest to 100%; combined both under Fletcher Challenge Canada Ltd.	573	1988
Kinburn Industrial Corp.	Increased share in Paperboard Industries to 98% from 51.8%	72	1988
Olympia & York	Raised stake in Abitibi to about 74.8% as of Jan. 11, 1988	n.a.	1988
Jefferson Smurfit Corp.	50% stake in Temboard & Co. Ltd.	30	1988
Abitibi-Price Inc.	Gulf Canada Ltd. spins off its 83% share of Abitibi, increasing the public float of Abitibi shares to 27%	n.a.	1987
Cascades Inc.	Acquired 32% of "Class B" voting stock and 28.7% of "Class A" nonvoting stock of Rolland Inc. in takeover attempt	4.5	1987
Domtar Inc.	Genstar Corp.'s gypsum wallboard operations	241 (US)	1987
Fletcher Challenge Ltd.	Acquired 47% of British Columbia Forest Products Ltd.	505	1987
Oji/Canfor	Howe Sound Pulp Div.	307.5	1987
Paperboard Industries Corp.	Acquired more than 95% of common shares and more than 92% of nonvoting shares of Belkin Inc.	219.5	1987
Quebecor Inc. and British Printing & Communication Corp.	Purchased 56% share of Donohue Inc. held by Quebec government	320	1987
St. Raymond Paper Inc.	Mill president purchases 60,000-tpy groundwood mill (Chute Panet) from Imperial Trust of Montreal	n.a.	1987
Timber Investments Ltd.	Acquired over 99% of outstanding shares of Balco Industries Ltd.	27	1987
Weldwood of Canada	St. Regis Paper Co. (Canada) from Champion	264	1987
Cascades Inc.	60-metric-tpd roofing felt mill at Joliette, Que., from Canadian Gypsum Co. Ltd.; paper machines at Nitec Paper Corp.'s Niagara Falls, N.Y., mill	n.a., 1.75	1986
Consolidated-Bathurst, Power Corp. of Canada, China International Trust & Investment Corp.	Westar Timber Ltd.'s Castlegar, B.C., pulp mill	95	1986
Gordon Investment Corp. and Merrill Lynch Canada Inc.	26.3% stake in BCFP held by Brunswick Pulp & Paper Co. and 15.2% stake in BCFP held by Mead Corp.	n.a.	1986

Continued

Merrill Lynch Canada Ltd. Fletcher Challenge eventually acquired a 47% stake in the initial offering, and in January 1988, it increased its holdings to 67.4% while simultaneously completing its buyout of Crown Forest Industries Ltd. Together, the two acquisitions gave Fletcher Challenge a substantial interest in the Canadian industry, with assets estimated at over $2 billion.

The following year, Fletcher Challenge merged the management groups of Crown Forest and BCFP under a new company called Fletcher Challenge Canada Ltd. This was a novel way of consolidating assets. Although Fletcher Challenge owned 100% of Crown Forest, it held only a 69% stake in BCFP and had no intention of raising its stake in the near-term. The merger allowed Fletcher Challenge to control both operations, take advantage of synergies and cost savings, and spend its acquisition dollars elsewhere.

Not all acquisitions proceeded as smoothly. Paperboard Industries Corp. bought a controlling interest in Belkin Inc.

MAJOR CANADIAN PAPER INDUSTRY ACQUISITIONS (continued)

Acquiring company	Assets purchased	Estimated value (million C$)	Year
Paperboard Industries Corp.	Big M Paperboard's Palmyra, Mich., recycled board mill	C$1.145	1986
Repap Enterprises Inc.	Westar Timber Ltd.'s Prince Rupert, B.C., kraft market pulp mill	110	1986
Waferboard Corp.	Abitibi-Price Inc.'s Smooth Rock Falls, Ont., bleached kraft market pulp mill	45	1986
Weyerhaeuser Canada Ltd.	Prince Albert Pulp Co. Ltd.	248	1986
Canfor Corp.	25% share of International Pulp Co. Ltd. held by Feldmühle AG	n.a.	1985
Cascades/Rexfor	ITT Rayonier's mothballed Port Cartier, Que., dissolving pulp mill; government financing approved in early 1986	17	1985 1985
CIP Inc.	50% of Tahsis Co. Ltd. not already owned	n.a.	1985
Gulf Canada Ltd.	90% of Abitibi-Price Inc. from Olympia & York in four installments; shares reduced to approximately 83.4% after Abitibi stock offering in April 1986	1,200	1985
Noranda Inc.	32% of Fraser Inc. not already owned	60	1985
Rauma-Repola Oy	25% of St. Marys Paper Co.	n.a.	1985
Repap Enterprises Inc.	Boise Cascade Canada Ltd.'s Newcastle, N.B., kraft market pulp mill	90 (US)	1985
St. Marys Paper Inc.	Sault Ste. Marie, Ont., mill of Abitibi-Price	n.a.	1984
Cascades Inc.	Jonquière, Que., mill of Abitibi	n.a.	1984
Bowater Inc.	Bowater Canadian Ltd., spun off from Bowater Corp.	57	1984
Kruger Inc.	Bowater Inc.'s Corner Brook, Nfld., mill	n.a.	1984
Cascades Inc.	Manville Corp. of U.S.'s 50% share of Papier Kingsey-Falls mill; balance already held by Cascades	1.2	1984
Fraser Inc.	50% of Island Paper Mills at New Westminster, B.C.	25	1983
Fletcher Challenge Ltd.	96% of Crown Zellerbach Canada (since renamed Crown Forest Industries) mill at Campbell River, B.C.	242 (US)	1983
Western Pulp Limited Partnership	Western Forest Products' Port Alice and Squamish, B.C., mills	150	1983
James River Corp. (80%) and Buchanan Forest Products (20%)	Marathon, Ont., mill of American Can	10.5	1983
Cascades Inc.	East Angus, Que., mill of Domtar	n.a.	1983
Employees and outside investors	Bowater's Perkins Papers Ltd. mill at Candiac, Que.	n.a.	1983
Fletcher Challenge Ltd.	84% interest in Crown Zellerbach Canada Ltd.	242	1982
Noranda Mines Ltd.	49% of MacMillan Bloedel Ltd.	n.a.	1981
Brascan Ltd.	Raised stake in Noranda Mines Ltd. to 39% from 22%	1,100	1981
Olympia & York Developments Ltd.	Increased stake in Abitibi-Price Inc. to 88%	530	1981
Canadian Pacific Enterprises Ltd.	Canadian International Paper Co.	1,100	1981
Alberta Energy Co.	Noranda Mines Ltd.'s 28% stake in British Columbia Forest Products Ltd.	215	1981
Belkin Packaging Ltd.	Continental Group's two Canadian boxboard mills and three folding carton plants	60	1981
British Columbia Forest Products Ltd., Doman Industries Ltd., and Whonnock Industries Ltd.	Rayonier Canada, division of ITT Industries of Canada Ltd.	420	1980

n.a. = Not available.

of Vancouver, B.C., in a deal that made it Canada's largest recycled paperboard and packaging company. In February 1988, the company was taken private when Kinburn Industrial Corp. raised its stake to 98% from 51.8%.

By early 1990, however, Kinburn reportedly was in severe financial difficulties and found itself unable to meet payments on C$816-million-worth of loans due in April. Kinburn's controlling shareholder Roderick Bryden hoped to sell the holding company's assets to his biggest lender, BCE Inc. of Montreal. Kinburn had revenues of C$1.7 billion in 1989.

Somerville Packaging, a unit of Paperboard Industries, agreed to sell its Pure Pak milk carton business to International Paper Canada Inc. late in 1989. Pure Pak was the only nonintegrated manufacturer of milk and juice packaging in Canada.

In mid-1987, Bowater Inc. was prevented from acquiring control of Canadian forms manufacturer R.L. Crain Inc. A Supreme Court ruling in Ontario upheld the Crain family's multiple voting rights, effectively thwarting the Bowater move.

Cascades was also blocked in its attempt to wrest control of Rolland Inc. from Rolland family interests. Cascades purchased 32% of Rolland's voting stock and another 29% of nonvoting stock in early 1987. Nevertheless, Cascades was denied a seat on Rolland's board of directors, and the family retained its controlling share in the company.

Foreign investment trend. By late 1987, it was apparent that foreign investment would be the new trend in the Canadian pulp and paper industry. In December 1987, Oji Paper Co. Ltd. of Japan and Canfor announced they would form a partnership to acquire Canfor's Howe Sound Pulp Div. at Port Mellon, B.C., and its Westcoast Cellufibre Industries sawmill and chipping plant at Vancouver. The new company, Howe Sound Pulp & Paper Co. Ltd., is building a 200,000-metric-tpy newsprint machine that is slated to start up in 1991. Oji will market the output.

Canfor announced in September 1989 that it would sell its assets in northern Alberta, including a plywood plant, three sawmills, and related woodlands operations. The sale also covered cutting rights to almost 2 billion m^3 of wood. Proceeds were to be used to help fund $300 million worth of ongoing capital projects at two pulp mills—one in Prince George, B.C., and the other at Howe Sound Pulp & Paper.

In February 1988, Daishowa Paper Manufacturing Co. committed to building a 340,000-tpy bleached kraft market pulp mill near Peace River, Alta. The C$500-million project was expected to be completed in 1990, with much of the output marketed in Japan. The federal government agreed to provide $9.5 million for "infrastructure," and the province contributed $65.2 million for rail and road access.

The Japanese made their biggest Canadian investment in mid-1988. Daishowa announced it would buy Reed International plc's North American Paper Group for C$565 million plus an amount equal to after-tax profits earned from Apr. 2 (the end of the 1988 fiscal year) until the deal closed. Daishowa also agreed to assume an estimated $66 million in debts.

The deal, which concluded later in the year, included Reed's 432,000-tpy newsprint mill at Quebec City, Que., which also makes 35,000 tpy of boxboard and 20,000 tpy of sulfite pulp for market. The Reed acquisition made Daishowa one of the largest foreign investors in Canadian pulp and paper, with a 25% interest in Cariboo Pulp & Paper Co., a 50% share in Quesnel River Pulp Co., and the recent investment in the Peace River mill. Reed was also Daishowa's first venture into the eastern Canadian market.

At about the same time, another overseas investor was looking at a Canadian company. The Kuwait Investment Office (KIO) bought 10.3% of Con-Bath for $200 million. Power Corp. of Canada retained its approximately 40% majority stake. The other major shareholder was Associated Newspaper Holdings plc of the U.K. with a 15% interest.

Kuwait's interest in Con-Bath paled in comparison with Stone Container Corp.'s C$2.6-billion tender offer in January 1989. Con-Bath's three major shareholders agreed to sell their stakes—amounting to about 65% ownership—to Stone. The offer of $25/share for 100% of the outstanding shares was a 50% premium over the stock's price at that time. The merged operations created the second-largest pulp and paper company in the world. It also gave Stone third-place position among North American newsprint producers and ranked it among the continent's top ten market pulp suppliers. The Con-Bath operations were kept separate, although Stone changed the Canadian division's name to Stone-Consolidated Ltd. The deal also included Con-Bath's overseas operations.

Late in 1989, Stone-Consolidated completed a C$46.5-million buyout of just over 4 million shares of CB Pak Inc. that it did not already own. Stone already owned nearly 17 million shares, or about 80% of the firm's holdings. Stone-Consolidated reportedly meant to sell CB Pak's remaining assets and liquidate the firm. That was expected to bring in about $200 million.

Stone Container found itself in something of a bind the following year. The U.S. firm had taken on $12.6 billion in senior long-term debt, in part to fund the Con-Bath purchase. Though Stone had made interest payments easily, the company announced in mid-1990 that banks would be willing to lend it $400 million to help it through an earnings downturn and to repay debt coming due in September. Arnold Brookstone, chief financial officer, reportedly said the credit facility was not "an expression of any inability to make our payments" but instead reflected the firm's belief in contingency planning. Stone Container had earlier sold timberland in Florida to the John Hancock Mutual Life Insurance Co. for $65 million to retire debt. Other timberlands had been sold the previous two years.

Another U.S. investment in Canada occurred in late 1988, when Tembec Inc. sold to Jefferson Smurfit Corp. a 50% stake in its new 140,000-metric-tpy bleached paperboard mill at Temiscaming, Que. Smurfit paid about C$30 million for an undisclosed number of partnership units in Temboard & Co. Ltd. Partnership, the entity formed to build and finance the new mill.

Canadian investment up too. While foreign investors made their mark on the Canadian pulp and paper industry, acquisition activity from within the country was also on the rise. Early in 1988, Weldwood of Canada Ltd. bought St. Regis Paper Co. (Canada) Ltd. from Champion International Corp. in exchange for 16.5 million Weldwood shares, giving Champion an 84.6% ownership in Weldwood. This gave Weldwood control of the 182,000-tpy bleached softwood kraft market pulp mill at Hinton, Alta.

At about the same time, Olympia & York announced it had acquired another 1.5 million common shares of Abitibi-Price, raising its stake to about 74.8% of the company's common shares as of Jan. 11, 1988. Its stake had increased to 84% by October 1989.

Abitibi announced early in 1990 that it would undertake a broad review of its operations in an effort to focus on essential tasks and reduce expenses. The firm, which was the second-largest newprint producer in the world, was battered by low earnings in the sector in 1989 and faced a similarly tough situation in 1990. The firm had permanently idled a newsprint machine the previous December, and more closures were expected. But Abitibi was due to regain first place in newsprint capacity when its 50%-owned Alabama River Newsprint Co. mill in Alabama started up later in 1990.

Other companies went looking for buyers. After several attempts to sell Manfor Ltd. in 1980, the province of Manitoba put the company back on the block in January 1988. Because of better markets and the company's improved financial condition, the province was confident it would find a buyer for the 150,000-tpy unbleached kraft market pulp and paper mill at The Pas, Man. Conditions were placed on the sale, such as further investment, employment, and use of resources.

In early 1989, Repap Enterprises agreed to acquire Manfor in a deal valued at C$132 million. Repap paid the Manitoba government $40 million in cash and $92 million in preferred Repap shares redeemable at the company's option.

Probably the biggest ownership upheaval of 1988 was the merger of Great Lakes Forest Products Ltd. with CIP Inc., creating the second-largest North American producer of pulp and newsprint. In June, shareholders approved the joining of the two Canadian Pacific Ltd. subsidiaries. The new company, Canadian Pacific Forest Products Ltd., is headquartered in Toronto, Ont. CP's 54.3%-held GLFP unit issued about 24.4 million common shares to CP in exchange for all of the shares of the wholly owned CIP, giving CP about 79.9% of the merged company in a deal val-

FOREIGN OWNERSHIP OF CANADIAN PULP AND PAPER COMPANIES

Company	% owned	Foreign owner	Assets
Alberta Newsprint	50.00%	West Fraser Timber, U.S.	Newsprint mill, Athabasca, Alta.
Beaver Wood Fibre	100.00	Georgia-Pacific, U.S.	Paperboard mill, Thorold, Ont.
Boise Cascade Canada	100.00	Boise Cascade, U.S.	Pulp/paper mills, Fort Francis and Kenora, Ont.
Bowater Mersey	49.00	Washington Post, U.S.	Pulp/newsprint mill, Liverpool, N.S.
	51.00	Bowater, U.S.	
Cariboo Pulp & Paper	50.00	Champion International[1], U.S.	Market pulp mill, Quesnel, B.C.
	50.00	Daishowa Marubeni International, Japan	
Celgar Pulp	50.00	CITIC B.C., People's Rep. China	Market pulp mill, Castlegar, B.C.
	25.00	Stone-Consolidated, U.S.	
Crestbrook Forest Industries	32.24	Honshu Paper, Japan	Market pulp mill, Skookumchuck, B.C.
	32.24	Mitsubishi Paper Mills Ltd., Japan	
Crown Forest Industries	100.00	Fletcher Challenge, New Zealand	Pulp/paper mill, Campbell River, B.C.
Daishowa Canada	100.00	Daishowa Paper, Japan	Proposed mill
Donohue	27.00	Maxwell Communications Inc.[2], U.K.	One pulp/paper mill, plus holdings
Donohue-Malbaie	49.00	New York Times, U.S.	One machine, Clermont, Que.
Eurocan Pulp & Paper	50.00	Enso Forest Products (Enso-Gutzeit Oy), Finland	Pulp/paper/paperboard mill, Kitimat, B.C.
	50.00	West Fraser Timber, U.S.	
Fletcher Challenge Canada	72.00	Fletcher Challenge, New Zealand	Pulp/paper mills in B.C. and U.S.
Gaspesia Pulp & Paper	49.00	New York Times, U.S.	Pulp/newsprint mill, Chandler, Que.
Glassine Canada	100.00	Simkins Industries, U.S.	Paper mill, Quebec City, Que.
Gold River Newsprint	39.5	Nine partners in U.S., U.K, Japan, Singapore	Newsprint mill in Gold River, B.C.
Howe Sound Pulp & Paper[3]	50.00	Oji Paper, Japan	Joint venture
James River-Marathon	80.00	James River, U.S.	Market pulp mill, Marathon, Ont.
Kimberly-Clark of Canada	100.00	Kimberly-Clark, U.S.	Four pulp or paper mills, Ontario
NBIP Forest Products	25.00	Oji Paper Co., Japan	Pulp/newsprint mill, Dalhousie, N.B.
	8.00	Mitsui, Japan	
Northwood Pulp & Timber	50.00	Mead, U.S.	Market pulp mill, Prince George, B.C.

Continued

ued at C$1.26 billion.

A year later, Normick Perron Inc., eastern Canada's top lumber producer and a partner in the Donohue Normick newsprint mill at Amos, Que., offered a 41% majority stake held by brothers Michel and Jean Perron. Tembec appeared to be the successful bidder, with an offer valued at C$132 million. However, Maclaren Industries Inc., a 24% equity owner, later exercised its right of first refusal and paid about $120 million for that block of shares. Noranda Forest Inc., which owned Maclaren, was expected to gain control of Normick Perron and operate it as part of Maclaren.

One of the deal's attractions for Maclaren was the timber resources. Meanwhile, Tembec acquired three Ontario sawmill operations from G.W. Martin Lumber Ltd. of Harcourt, Ont.

Consolidation continues. In January 1989, West Fraser Timber Ltd. entered the paper business by acquiring a 50% interest in Alberta Newsprint Co. Ltd., a joint-venture firm that finished building a 220,000-tpy greenfield newsprint mill at Whitecourt, Alta., in 1990.

Scott Paper Ltd., the Canadian affiliate of Scott Paper Co., reached an agreement in 1989 to buy E.B. Eddy Forest Products Ltd.'s White Swan Tissue Div. at Hull, Que., for approximately C$110 million. This marked Eddy's exit from the tissue business.

In mid-1989 Brascan Ltd., a Toronto-based holding company controlled by Peter and Edward Bronfman, sold 8 million outstanding warrants worth C$240 million back to Scott Paper Co., representing about 10% of Scott's equity. Scott had issued the warrants as partial payment for a 25% block of common shares repurchased from Brascan after Scott thwarted the company in a takeover attempt in 1985.

In the second half of 1989, Scott Paper Ltd. decided to sell its 50% stake in Sancella Inc. to its joint-venture partner Mölnlycke AB of Sweden for an undisclosed amount. This was part of Scott's strategy to focus on growth opportunities in personal care and cleaning products in the Canadian market.

Also that year, Kruger Inc.'s chairman Joseph Kruger II and his family paid C$100 million for a 32% stake in the company held by Bernard Kruger and his four children, ending a long feud over control of the company. The offer was extended to include buying out the remaining outstanding shares, amounting to a 6% interest, at $22 each.

Malette Inc. and Rexfor, Quebec's forest agency, finalized a deal early in 1990 to form a joint venture to buy the

FOREIGN OWNERSHIP OF CANADIAN PULP AND PAPER COMPANIES (continued)

Company	% owned	Foreign owner	Assets
Procter & Gamble Cellulose	100.00%	Procter & Gamble, U.S.	Market pulp mill, Grande Prairie, Alta.
Quebec & Ontario Paper	100.00	The Tribune, U.S.	Pulp/newsprint mills, Baie Comeau, Que.; Thorold, Ont.
Quesnel River Pulp	50.00	Daishowa Canada, Japan	Market pulp mill, Quesnel River, B.C.
	50.00	West Fraser Mills (West Fraser Timber)[4], U.S.	
St. Anne Nackawic Pulp & Paper	100.00	Parsons & Whittemore, U.S.	Market pulp mill, Nackawic, N.B.
St. Marys Paper	25.00	Rauma-Repola, Finland	Pulp/paper mill, Sault Ste. Marie, Ont.
Scott Paper Ltd.	50.00	Scott Paper Co., U.S.	Pulp/paper mills in B.C., Quebec
Scott Maritimes	100.00	Scott Paper Co., U.S.	Market pulp mill, Abercrombie Point, N.S.
Slave Lake Pulp	25.00	MoDo CellKraft, Sweden	Pulp mill, Slave Lake, Alta.
Sonoco Ltd.	100.00	Sonoco Products Co., U.S.	Paperboard mill, Brampton, Ont; Terrebonne, Que.
F.F. Soucy	100.00	Brant-Allen Industries, U.S.	Pulp/newsprint, Rivière-du-Loup, Que.
F.F. Soucy et Associés	50.00	Brant-Allen Industries, U.S.	Paper mill, Rivière-du-Loup, Que.
	40.00	Dow Jones, U.S.	
Stone-Consolidated	100.00	Stone Container Corp.	Eight mills
Stora Forest Industries	100.00	Stora, Sweden	Pulp/newsprint mill, Port Hawkesbury, N.S.
Temboard & Co. Inc.	50.00	Jefferson Smurfit Corp., U.S.	Bleached board mill, Temiscaming, Que.
Weldwood of Canada[5]	84.60	Champion International, U.S. (see Cariboo Pulp & Paper)	Market pulp mill, Hinton, Alta.
Weyerhaeuser Canada	100.00	Weyerhaeuser Paper, U.S.	Market pulp mills, Kamloops, B.C.; Prince Albert, Sask.

1. Through Weldwood of Canada.
2. Mircor Inc. was set up to buy 55.25% of Donohue stock from Dofor (a government body). British Printing owns 49% and Quebecor owns 51% of Mircor.
3. Proposed venture combining existing Howe Sound Pulp Div. and Oji investment in newsprint mill.
4. West Fraser Timber Co. is majority-owned by Ketcham family of U.S.
5. Weldwood acquired 100% of Champion Forest Products (Alberta) Ltd.'s mill at Hinton, Alta., early in 1988, at which time Champion's interest in Weldwood

assets of St-Raymond Paper Inc. The newsprint and groundwood facility had been closed by bankruptcy the year before as a result of rising pulp prices and plummeting newsprint tabs. About $125 million was to be spent on converting the mill to machine-finish coated publication paper.

Louisiana-Pacific Corp. launched a friendly takeover bid in 1988 for Doman Industries Ltd., a British Columbia-based forest products firm. Doman held a stake in Western Forest Products Ltd., which was possibly L-P's ultimate target. L-P abandoned the attempt a month later. Then in the last quarter of 1989, Doman increased its stake in Western Forest Products to 56%. The C$137-million deal included an option to buy the remaining 44% interest held by Toronto-Dominion Bank and Royal Bank of Canada. In the two-step transaction, Doman bought out International Forest Products Ltd.'s 21% stake in WFP, while WFP bought back a 23% interest held by Fletcher Challenge Canada. The FCC stake was cancelled, raising the WFP stakes held by the remaining owners. This made Doman the tenth-largest integrated forest products company in Canada. The two banks were left with a 44% stake in WFP.

L-P then hiked its share in Doman to 14.7% in mid-1990, fueling rumors that it might make a second run at the company. The 14.7% shareholding falls short of the 20% level deemed to be a controlling interest under Canadian securities law. If L-P did eventually manage to acquire a controlling interest in the Canadian firm, it would benefit from Doman's access to B.C. forestland and sawmill byproducts.

Canada:

LABOR

The largest labor union in the Canadian pulp and paper industry is the Canadian Paperworkers Union (CPU), which has about 70,000 members. About 11,500 members work in the Maritime provinces, 26,700 in Quebec, 20,700 in Ontario and Manitoba, and 10,700 in the Prairies and British Columbia. CPU is a member of the Canadian Labour Congress. Over 14,000 Quebec paper industry workers are represented by La Fédération des travailleurs du papier et de la fôret (Federation of Paper and Forestry Workers), affiliated with the Confederation of National Trade Unions (CNTU). Another major Canadian union, Pulp & Paper Workers of Canada (PPWC), has about 7,300 members, most of them in British Columbia. The United Paperworkers International Union (UPIU), with the majority of its membership in the U.S., represents about 2,500 workers in Ontario and Manitoba. CPU broke off from UPIU in 1974.

The contract bargaining focus in Canada usually alternates between the East and the West. In eastern Canada, CPU traditionally targets a major company with which to work out a labor contract and then uses it as a role model in negotiations with other companies bargaining that year. As it is the largest paper company in eastern Canada, Abitibi-Price Inc. traditionally has been the union's target. In 1990, however, CPU targeted Stone-Consolidated Inc., but, as later developments made clear, Abitibi proved to be the true bellwether company in establishing a model contract.

On the West Coast, most companies belong to two collective bargaining groups called Forest Industrial Relations Ltd. and the Pulp & Paper Industrial Relations Bureau, which act as industry-wide bargaining agents. The former group bargains for the timber sector of the industry, while the latter handles pulp and paper industry negotiations. In eastern Canada, the industry does not bargain collectively except for four companies in Quebec: Domtar Inc. at Dolbeau, Daishowa Forest Products Ltd. (formerly Reed Inc.)

CANADIAN PAPER INDUSTRY WORKERS' UNIONS

Union	Region represented	Number of members	Number in primary pulp and paper
Canadian Paperworkers Union (CPU)	Canada	70,080	43,880
	Maritimes	11,490	7,615
	Quebec	26,670	15,275
	Ontario and Manitoba	20,795	12,275
	Saskatchewan, Alberta, and British Columbia	10,680	8,715
Le Fédération des travailleurs du papier et de la fôret (FTPF-CNTU)	Quebec	14,000	6,000
Pulp & Paper Workers of Canada (PPWC)	Western Canada	7,300	5,500
United Paperworkers International Union (UPIU)	Ontario and Manitoba	2,500	1,600

Note: Pulp and paper workers are also represented in Canada by such major unions as the International Assn. of Machinists & Aerospace Workers, International Brotherhood of Electrical Workers, and others.

at Quebec City, Quebec & Ontario Paper Co. at Baie Comeau, and James Maclaren Industries Inc. at Buckingham. The consortium is known as the Eastern Canadian Newsprint Group, but the companies expressed dissatisfaction with the bargaining group, particularly during the 1990 CPU strike at two of the mills.

Unions in the Canadian pulp and paper industry tend to wield more bargaining power than their U.S. counterparts because of a highly centralized bargaining pattern. Unions also benefit from certain prolabor government policies, such as those prohibiting companies from operating mills during walkouts. Quebec's antiscab laws are noted to be the most restrictive. However, recent contract settlements indicate that the Canadian unions are scaling back their demands in view of the industry's willingness to take downtime rather than agree to costly contracts.

Canadian unions have proved capable of staging prolonged strikes, ranging from several weeks to several months, in order to attain contract demands. In 1981, a six-week strike by 60,000 members of CPU, PPWC, and IWA shut down the entire British Columbian forest products industry. The strike cost companies an estimated C$18 million/day in sales revenue, while employees lost in excess of $8 million/day in earnings. Western workers struck again in 1984 for 12 weeks. Several factors will determine whether or not a downturn in the economic cycle will lead to strained negotiations, but the agreement reached in the West in 1988 marked the second consecutive contract the British Columbian industry had reached without any major disruptions. But the tumultuous bargaining season in the East in 1990 may be an indicator of difficulties in the West in 1991.

STRIKES AND COMPROMISE IN EASTERN CANADA

In September 1989, Roger Stone, CEO of Stone-Container Corp. of Chicago, Ill., warned the Canadian industry that the free-trade agreement with the U.S. would create unprecedented challenges for Canadian mills. In a speech to the Assn. of Independent Corrugated Converters of Canada, Mr. Stone said that wage rates in Canada were too high and that Canadian labor must accept wage and benefit increases commensurate with those in the U.S. "Improving productivity may take a change in the psychology of running Canadian plants," Stone said.

At its annual Wage Conference in Montreal in February 1990, CPU established an agenda that called for an 8% yearly wage increase with additional cost-of-living adjustments. The agenda also placed heavy emphasis on job security and health and safety issues. When the union, to general surprise, chose Stone-Consolidated, the former Consolidated-Bathhurst Inc., as the 1990 target company, the battle lines were drawn.

While the industry was reeling from poor markets and the makings of a "made-in-Canada" recession, contracts expired Apr. 30, 1990, for almost 30,000 paper industry workers in the eastern provinces. With newsprint prices bottomed out, and a fragile June 1 price increase gaining momentum, the union countered the market benefits of newsprint capacity downtime with Stone-Consolidated's need for operating cash flow in order to carry its heavy debt, most of which came from the ConBath buyout for $2.2 billion in March 1989.

The two sides talked tough going into negotiations yet, without a strike, were able to hammer out a compromise contract that not only provided an attractive pay hike and vacation pay raise for workers but also allowed the company flexibility with job descriptions and the ability to operate its mills on two statutory holidays. Although the contract was an achievement for both sides, doubt rose immediately as to if it would be able to provide a model to other Canadian companies with worse outlooks than Stone. CPU was al-

CANADIAN PULP AND PAPER EMPLOYMENT AND EARNINGS

			Yearly change		% change	
Year	Employees	Salaries/ wages	Employees	Salaries/ wages	Employees	Salaries/ wages
1987	80,334	C$3,113,977	764	C$114,745	1.0%	3.8%
1986	79,570	2,999,232	2,008	188,431	2.6	6.7
1985	77,562	2,810,801	-1,842	171,996	-2.3	6.5
1984	79,404	2,638,805	240	110,451	0.3	4.3
1983	79,164	2,528,354	-3,940	86,228	-4.7	3.5
1982	83,104	2,442,126	-4,778	132,324	-5.4	5.7
1981	87,882	2,309,802	1,010	260,059	1.2	12.7
1980	86,872	2,049,743	-179	202,615	-0.2	11.0
1979	87,051	1,847,128	1,450	150,359	1.7	8.9
1978	85,601	1,696,769	1,068	155,414	1.3	10.1
1977	84,533	1,541,355	-2,462	125,511	-2.8	8.9
1976	86,995	1,415,844	2,949	324,168	3.5	29.7
1975	84,046	1,091,676	-2,157	-5,422	-2.5	-0.5
1974	86,203	1,097,098	6,118	212,856	7.6	24.1
1973	80,085	884,242	1,116	75,373	1.4	9.3
1972	78,969	808,869	-428	63,261	-0.5	8.5
1971	79,397	745,608	-974	44,213	-1.2	6.3
1970	80,371	701,395				
Average						
1981-84			-1,867	147,016	-2.2	6.6
1976-80			565	191,613	0.7	13.7
1971-75			1,162	86,517	1.5	10.3

Source: *Statistics Canada.*

ready on strike at Irving Pulp & Paper Ltd.'s Rothesay Paper Ltd. newsprint mill in St. John, N.B., precisely over flexible trades and vacation pay issues. Maintenance workers at Rothesay struck Apr. 10, 1990, while CPU-represented paperworkers were forced back to the job by court order. Pulp and tissue workers across the street had also struck but established a contract by May 25. The schism in St. John was a microcosm of later developments in the pattern contract negotiations that saw workers in one mill oppose items accepted by workers in another.

The pattern settlement ran into early trouble in negotiations for the Eastern Canadian Newsprint Group. In a sort of play on words, the provisions in the Stone contract that allowed flexibility and holiday run-throughs were considered "local issues" by CPU leadership. The union pledged its support to any local that opposed those concessions. But CPU workers struck James Maclaren Industries' Buckingham newsprint mill on July 26 and Quebec & Ontario Paper's Baie Comeau newsprint mill two days later over two other provisions in the pattern accord, namely a shorter work week for maintenance employees and increased vacation pay. On Aug. 14, CPU struck Q&O's Thorold, Ont., recycled newsprint mill over the flexibility and holiday run-through provisions.

Meanwhile, the pattern agreement was bolstered by its acceptance at Abitibi's Kenogami mill in Jonquière, Que., by members of FTPF. By late August, the ECNG strikes were settled, based on pattern provisions, and a similar accord was reached at Kruger Inc. in Trois Rivières, Que.

Yet despite the contract agreements in the St. Maurice Valley, CPU locals in many places were determined to prevent the work-rule flexibility and holiday run-through concessions. Workers were becoming disenchanted at the lack of gains in job security and cost-of-living language. Negotiations at Abitibi-Price faltered, and, on Sept. 10, union workers struck seven of nine locations, involving nearly 4,000 employees. Strikes also occurred Sept. 12 at Canadian Pacific Forest Products Ltd. mills in Dalhousie, N.B., and Gatineau, Que. Simultaneously, however, accords were reached at two other Abitibi and CPFP mills. By late September, with Rothesay and Q&O's Thorold mill still out, about 23% of Canada's newsprint capacity was shut down in strikes at 11 facilities.

While those strikes raged, CPU settled at Stone's Portage du Fort, Que., mill, and several other companies in Quebec and the Maritimes also reached accords similar to the pattern agreement. FTPF achieved a pact that exceeded the wage hike contained in the Stone pattern deal. At Scott Paper Ltd.'s Crabtree, Que., tissue mill, FTPF members would receive a wage hike of 19.1% over three years.

The summer bargaining quickly became fall negotiations and appeared destined to be settled into winter. The strike at Abitibi's seven mills ended Oct. 9, when the company backtracked on the two most contentious issues, but two days later, while observers expected the Abitibi breakthrough to bring progress to the other strikes, over 1,700 workers shut down CPFP's massive Thunder Bay, Ont., newsprint and pulp operation.

Identical to the Stone pattern agreement, the Abitibi contract called for a pay hike of 85¢ in the first year, and 5.5% in each of the next years, lifting wages 16.5% by 1992, an increase of take home pay of $11,000 on the average. Vacation pay was lifted to 2.4%, a 20% improvement, and workers granted the company increased flexibility in assigning work to maintenance employees and tradesmen. But unlike the pattern deal, Abitibi would need the permission of its union locals in order to operate its mills on statutory holidays, and the union won job security language that is designed to protect workers in the event of machine and mill shutdowns that could lead to the loss of jobs.

OUTLOOK FOR THE WEST

On July 1, 1991, labor contracts for about 17,000 union workers in the Prairies and British Columbia expire, and the CPU has scheduled conference earlier in the year to establish its agenda. In July 1988, CPU and PPWC accepted a three-year pact that lifted western paperworkers' base wages to $17.07/hour by mid-1990. The 1988 settlement was considerably higher than the one reached in 1987 by most mills in eastern Canada, and even the East's 1990 model contract will not close the gap in pay between the two coasts. As the Canadian dollar continues to rise and inflation continues to increase, the traditional gap between wages in the East and the West will also expand.

CPU's vice president for British Columbia, Norman MacLellan, said the union will be looking for greater wage protection against the effects of Canada's controversial Goods and Services Tax, which was to be implemented in January 1991. CPU also wants improvements to its pension plan and greater job security, and it will oppose contracting out work. Although western workers had already accepted statutory holiday operations in 1988, MacLellan said they will oppose flexibility provisions that were accepted in the East in 1990.

"Flexibility will not be a problem if it is not on the employer's agenda," he said. "We will resist it with all our fiber." Similar to prenegotiation statements made in the East, western CPU leaders note that the pulp and paper industry has just come through an era of unprecedented profits, and workers will not be expected to pay for the downturn.

An official of the Pulp & Paper Industrial Relations Bureau expected 1991 negotiations to be driven by economics and the realities of supply and demand.

Canada:

TIMBER RESOURCES AND PULPWOOD CONSUMPTION

Canadian forests contain about 23 billion m³ of wood, according to Forestry Canada, and the volume is roughly three-quarters coniferous and one-quarter deciduous. The major species are spruce, pine, fir, and aspen/poplar.

The provinces are the predominant owners of the 244 million hectares of inventoried, productive forestland, holding an 80% share. Federal reserves represent a further 11%, and private holdings account for the remainder.

CANADIAN PULPWOOD CONSUMPTION

(000 m³)

Year	Roundwood	Total wood residue	Total wood
1988	46,805	56,272	103,077
1987	45,539	56,431	101,970
1986	45,483	46,664	92,147
1985	44,115	45,180	89,295
1984	42,597	44,204	86,801
1983	39,755	43,353	83,108
1982	38,926	37,015	75,941
1981	44,717	39,669	84,386
1980	44,462	41,674	86,136
1979	44,910	41,054	85,964
1978	43,824	37,590	81,414
1977	42,042	33,913	75,955
1976	42,056	34,840	76,896
1975	39,503	24,056	63,559
1974	50,858	30,301	81,159
1973	47,795	27,986	75,781
1972	46,516	23,891	70,407
1971	45,245	20,968	66,213
1970	48,339	17,387	65,726

Source: *Statistics Canada.*

More than half of the productive forestland is mature, 24% is immature, 9% is overmature, and 7% is unclassified. This data is from the latest national survey, conducted in 1986.

Under 1% of the forestland is undergoing regeneration, half through natural processes and half through active seeding and planting, according to the Canadian Pulp & Paper Assn. Approximately 860 million seedlings were planted in 1988—up from 245 million at the beginning of the decade and 10 million in 1960. But one-tenth of the nation's potentially productive forestland has not been restocked to provide second-generation timber, according to the Ministry of Forests.

Old-growth stands are becoming rarer. On the western coast of British Columbia, for instance, estimates on the amount of harvestable old-growth forests remaining range from about 15 to 30 years.

While harvesting has cut into the timber supply, nature has also had an impact. Fire losses in Canada last year were unprecedented, according to the American Forestry Assn. Encouraged by a four-year drought, fires ravaged 16.4 million acres in just six months. For the full year, the nation lost ten times the area that the U.S. did. And continued dry weather has led to concerns that 1990 may be just as bad.

But industry and government have been working together to ensure future harvests. In 1987, for example, legislation was passed mandating reforestation of any harvested Crown land. In 1985, British Columbia and the federal government set up a joint Forest Resource Development Agreement (FRDA) to put C$300 million into forest management over the next five years. British Columbia later indicated it wanted fo follow up with a second agreement at a funding level of $700 million.

Federal-provincial FRDAs providing matched federal funds for reforestation and other purposes were set up with the other provinces as well. But these agreements expired in six provinces in March 1989. Three more ran out in March 1990, including the one for British Columbia as well as the one for Quebec—also valued at $300 million.

In spite of British Columbia's inclination to double its FRDA, the federal government indicated in March 1989 that it might even have to back out of the first FRDA with the province in an effort to draw down the federal deficit.

The budget deficit also threatened renewal of the federal government's other FRDAs, including a $23-million forestry agreement with Alberta. Those funds went primarily for research into the potential of Alberta's huge aspen and poplar resources. In mid-1989, however, federal forestry minister Frank Oberle said he hoped to extend the six reforestation agreements that expired in 1989 for another year.

Outside of the FRDAs, the Forestry Dept.'s allocation in the 1989-90 fiscal year was $207 million—off about $28 million from the previous year's forestry expenditures. And annual regional development spending—used to fund the FRDAs—was expected to drop from $1.4 billion to $1 billion in the early 1990s.

By early 1990, British Columbia learned that the federal government would provide nowhere near the $350 million desired for a renewed FRDA. Ontario too was facing major cuts in government support. As of August, FRDAs for British Columbia, Ontario, Quebec, and the Prairie provinces were still unsettled.

The impact of budget constraints did not end with the FRDAs. In order to reduce costs and regulations, British Columbia considered privatizing management of its forests by converting timber-cutting rights to tree farm licenses (TFLs). TFLs permit a firm to be the sole occupant of a specified area and to cut timber there for 25 years. In a TFL, the company is responsible for reforestation and management. Forest licenses, on the other hand, give a company the right to a certain harvest each year for 15 years, though other firms can also operate in the same forest. In these areas, the province takes care of management.

The goal discussed in early 1989 was to hike the fraction of the allowable annual cut covered by TFLs in British Columbia from 26% to 67% by switching existing forest licenses into TFLs. Management of Crown-owned forestland would thus be handed over to the private sector.

In mid-1989, British Columbia's Forests Ministry announced that the conversion of existent TFLs would be deferred for as long as two years to give the newly established Forest Resources Commission a chance to evaluate their worth. (The British Columbia Ministry of Forests had set up the ten-member commission to help it manage the forest resource.)

Harvests in the region have ebbed and flowed. They were below the annual allowable cut for a number of years in the early 1980s, but they have been above allowable levels for the past three years, driven by rising demand. Timber harvested in 1989 topped 85 million m³, according to the provincial Ministry of Forests, with the annual allowable cut being 77 million m³. That harvest was down from 90 million m³ in 1987, but up from 50 million m³ 15 years earlier.

Large harvests have not ensured the health of British Columbian sawmills. In an attempt to slow a rash of local mill closures, British Columbia in spring 1989 more than doubled the fee it charged exporters to ship logs out of Canada. The action increased the fee to 100% of the difference between domestic and export prices. The fee hike was delayed for independent loggers through the New Year. Log exports from British Columbia had averaged 2.9 million m³

RECEIPTS OF WOOD RESIDUE

(000 m³)

Province/area	1989	1988	1987
Atlantic provinces	3,514	2,791	3,366
Quebec	17,131	17,410	16,746
Ontario	5,955	5,656	5,351
Prairie provinces	2,917	2,500	2,445
British Columbia	27,138	27,924	28,524
Total	56,655	56,281	56,432

Note: Data for British Columbia represent receipts of pulpwood because data on production of pulpwood, as such, are not available.
Source: *Statistics Canada*.

PULPWOOD RECEIPTS FROM ALL SOURCES

(000 m³)

Province/area	1989	1988	1987
Atlantic provinces	13,387	11,814	10,147
Quebec	13,290	12,621	12,437
Ontario	11,877	12,110	12,722
Prairie provinces	3,892	4,121	4,012
British Columbia	5,242	6,145	6,221
Total	47,688	46,811	45,539

Note: Data for British Columbia represent receipts of pulpwood because data on production of pulpwood, as such, are not available.
Source: *Statistics Canada*.

CONSUMPTION OF ROUNDWOOD AND WOOD RESIDUE

(000 m³)

Province/area	1989	1988	1987
Atlantic provinces	16,486	14,127	13,515
Quebec	28,887	28,860	27,942
Ontario	17,636	17,505	17,626
Prairie provinces	6,916	6,571	6,505
British Columbia	32,160	33,281	32,950
Total	102,085	100,344	98,538

Source: *Statistics Canada*.

over the previous five years, and the higher fee was expected to bring those exports down to 1 million m³ by 1991.

Provincial forests minister Claude Richmond noted that log exports in the first quarter of 1990 had dropped to the point where they represented less than 2% of the total harvest.

Early in 1990, British Columbia appointed a special consultant to determine whether or not individual firms working in the interior were being assessed fair stumpage rates relative to their competitors. Stumpage fees had increased to C$600 million/year at the time, and British Columbian forest companies complained that the higher rates and strong Canadian dollar were suppressing exports. Ottawa ultimately decided to allocate $43.5 million over five years to reduce the Canadian lumber industry's dependence on the U.S. market, which absorbs 80% of Canadian exports.

The complaint was tied to a 1986 softwood lumber trade agreement between Canada and the U.S. The agreement levied a 15% export charge on Canadian softwood lumber exports to the U.S. to avoid a threatened U.S. countervailing duty. The agreement left individual provinces with the option to reduce or eliminate the tax if they increased stumpage or other fees. In fact, British Columbia and the Maritimes that route.

Sinking lumber prices and a stronger Canadian dollar relative to U.S. currency contributed to a decline in Canada's share of the U.S. market after the pact was signed. Canada subsequently asked for a renegotiation but was rebuffed by its southern neighbor. The issue really heated up when charges arose early in 1989 that some Canadian firms were allegedly evading export taxes imposed by the agreement by misidentifying the origin of shipments. A government investigation could not substantiate the charges.

Disputes over timber have not occurred just on the international scene. In April 1989, Quebec's independent sawmills and their employees held a week-long lockout to protest the low prices they were receiving for their woodchips. At the time, the mills were receiving just $100/metric ton of chips, and they claimed they could not function if paid less than $125/metric ton.

Pulp mills had gained an advantage in 1987 when they won more logging rights in Quebec, ultimately allowing them 70% of woodchip production in the province. The independent sawmills hoped the province would set chip prices, but the forest minister, Albert Cote, decided instead that the market should determine prices.

Native-land claims have also been divisive. In mid-1989, British Columbia's highest court upheld a lower court's decision stopping Westar Timber Ltd. from logging in virgin forest north of the Babine River until land claims were settled. Aside from a few colonial treaties on southern Vancouver Island, all of the province is subject to aboriginal land claims. British Columbia's attorney general, who supported Westar, said the decision could open the floodgates to Native Americans with similar injunction applications.

In addition to land claims, natural forces, and government regulations, the health of the pulp market has also influenced the timber supply. Widespread downtime in 1990 among market pulp producers—taken in an attempt to support pulp prices and limit inventory buildup—cut back on chip consumption in British Columbia. And some sawmill curtailments also occurred as a result of high log prices, a poor lumber market, and lower chip prices. Inventory growth and the downward pricing trend on chips were expected to continue in the third and perhaps the fourth quarter.

However, timber supplies will likely tighten over the longer term, especially if a trend toward withdrawing forestland from harvesting agreements continues. The situation in Vancouver Island's Carmanah Valley is one example.

In spring 1990, British Columbia Forest Minister Claude Richmond orchestrated a compromise on a tree protection dispute involving the valley that apparently satisfied neither environmentalists nor industrialists. Richmond proposed legislation to protect giant, old-growth Sitka spruce trees in the valley by forming a park that would fall within MacMillan Bloedel Ltd.'s Tree Farm License No. 44 in the Alberni Region. No timber or mineral resource extraction would be permitted in the park, which contains the tallest Sitka spruce known in B.C. Richmond said the 3,592-hectare park would act as a buffer to the 100 hectares containing the giant trees, noting that "we must ensure that harvesting does not threaten the old-growth spruce environment." But he acknowledged that "we must also recognize the region's economic needs." The Forests Ministry said that harvesting would be allowed in the rest of the valley as long as studies show the lower valley would not be adversely affected. Nearly all the commercial timber in the forest is made up of hemlock, cedar, and balsam fir.

Preservation of the old trees would not be without cost. Richmond pegged the government's forest revenue losses at $600,000/year if the legislation was passed. And MB said the government action would cost the British Columbian economy $7 million annually, as well as about 150 jobs. The firm would not receive compensation for most of the park land, though restitution for loss of land that falls within a timber license may run into the millions of dollars. Annual timber harvest would be reduced by more than 35,000 m³. MB said that although logging in the entire valley had been frozen since 1988, the site accounts for 2.3% of the firm's allowable cut of 2.8 million m³ in the Alberni region.

The Carmanah Valley legislation and the possible loss of other timber resources in the region make the future of the company's Port Alberni kraft pulp mill increasingly uncertain. And the firm worried that the precedent set by the legislation could impact the more than 30% of Tree Farm Licence No. 44, which was targeted by environmentalists.

In light of such timber withdrawals, pulp mills might do well to keep a hand in the chip market. Some firms are already involved. In spring 1989, Canfor Corp. agreed to purchase the remaining shares of Balfour Forest Products Inc., Vancouver, B.C., for $93.75 million. Canfor reportedly bought Balfour in order to secure the chip supply for its two Prince George pulp mills—a supply that could have been cut off if competitors had made the move. At the time, Balfour held 1.75 million m³ of annual allowable cut in interior British Columbia, as well as five sawmills producing lumber and woodchips.

Daishowa Canada Co. Ltd. picked up Canfor Corp.'s High Level sawmill in northern Alberta early in 1990. Canfor was in the midst of unloading its lumber operations in the region in order to concentrate on its British Columbian pulp and paper mills.

The sawmill gave Daishowa a captive source of woodchips for a bleached kraft pulp mill under construction in Peace River. Annual capacity at the sawmill includes 240 million bd ft of lumber and 140,000 bdu of woodchips.

Procter & Gamble Cellulose Ltd., which used to source chips from the Canfor sawmill for its Grande Prairie, Alta., pulp mill, then bought Fletcher Challenge Canada Ltd.'s Grande Cache, Alta., sawmill.

The mix of chips available to mills is changing as the nature of Canadian forests changes. The Pulp and Paper Research Institute of Canada (Paprican) and Forintek Canada Corp. recently looked into the impact of the increasing use of second-growth timber on the pulp and paper industry. Trees of a managed shorter-rotation Douglas fir forest have much more juvenile or core wood than trees in a mature forest, Paprican noted. The researchers discovered that the second-growth timber yielded kraft pulps with shorter, less coarse, more flexible fibers than did the mature timber. And they concluded that those fibers were more suitable for papermaking, giving smoother, more opaque, and less bulky paper. Now the group is looking into the effect on pulps made from second-growth jack and lodgepole pines. Preliminary results appear to be similar to those with fir.

Canada:

ENERGY USE AND CONSERVATION

Thanks in part to record production levels, Canadian pulp and paper mills used 30.8% less purchased energy per ton of output in 1988 than in 1972, the base year established for comparison purposes by the Canadian Pulp & Paper Assn. In 1988, Canadian mills produced 3.7% more paper and paperboard and 2.3% more woodpulp than in 1987. Newsprint mills operated at 99% of capacity.

The oil-price shocks of the early 1970s led mills to explore virtually every avenue for relief from skyrocketing energy costs. These efforts, which continued into the 1980s despite lower energy prices, led in two basic directions: process improvements to reduce the energy needed to manufacture a ton of product and alternative energy sources to reduce mills' dependence on purchased power.

Process improvements have included more efficient pressing and drying equipment for paper machines, new heat recovery equipment, and better refiners. Mills have also been very successful in exploiting waste products as an alternative source of fuel. Woodwaste now accounts for 68% of the total fuel burned by the industry, while waste-fuels plus captive hydraulic power account for 57% of the total energy used, an increase of 42% from 1972.

Energy purchases cost the industry between 10% and 15% of sales revenues, according to Oakville, Ont.-based Aktrin Research Institute. Electricity, natural gas, and heavy fuel oil are the three major forms of energy bought by Canadian mills, accounting for 96.4% of total purchases in 1988. Electricity accounted for 43.4% of energy purchases in 1988, up from only 24.1% in 1972. Natural gas purchases have been steadier, rising from 20.1% of the total in 1972 to 28.8% in 1988. Over the same period, oil purchases plummeted by 69.3%—from a 51.1% share of the total in 1972 to only 25.6% in 1988.

Canada is fortunate its oil appetite has waned, as Iraq's invasion of Kuwait in 1990 had a significant impact on oil prices. Those prices stood at $20/barrel before the invasion, and then jumped as high as $32/barrel late in August, although they then dropped.

Energy consumption patterns differ across Canada. For example, the British Columbia

PURCHASED ENERGY USE IN CANADA

(gigajoules per metric ton of paper produced)

Year	Electricity	Heavy fuel oil	Distillates	Natural gas	Coal	Other*	Total
1988	5.6	3.1	0.2	3.7	0.2	0.0	12.8
1987	6.0	2.7	0.2	3.3	0.2	0.0	12.4
1986	6.1	2.9	0.2	3.3	0.2	0.1	12.8
1985	5.9	3.2	0.3	3.4	0.4	0.0	13.2
1984	5.7	3.6	0.3	3.5	0.4	0.0	13.5
1983	5.0	4.5	0.2	3.5	0.5	0.1	13.8
1982	5.0	5.6	0.3	4.0	0.5	0.2	15.6
1981	4.8	5.9	0.3	3.9	0.4	0.2	15.5
1980	4.5	6.0	0.4	3.9	0.5	0.2	15.5
1979	4.4	6.5	0.4	4.0	0.5	0.1	15.9
1978	4.7	7.0	0.3	3.9	0.6	0.2	16.7
1977	4.7	7.4	0.4	4.2	0.6	0.3	17.6
1972	4.5	9.0	0.3	3.8	0.7	0.2	18.5

*Purchased steam plus propane.
Source: Canadian Pulp & Paper Assn.

interior relies principally on natural gas, while the coastal region uses both oil and gas extensively, according to Aktrin. Eastern Canada tends to use electric power.

Hydro-Quebec's discount program encouraged greater use of electric boilers in Quebec, and process changes in pulping, air pollution control, and mechanical paper drying have increased mills' motive power requirements throughout Canada. However, Hydro-Quebec's five-year contract with mills expired in 1988-89, and Hydro has made it clear that the low electricity prices have ended for mills.

This is unfortunate for mills that were encouraged by low prices to install electric boilers. They will have to either pay the higher electricity prices or revert to using more residual oil and natural gas. This shift in consumption use can already be seen in comparisons of 1987 and 1988 data. Patterns of energy consumption differ widely for the Canadian industry's two main products—bleached kraft market pulp and newsprint. According to the Canadian Energy Research Institute, about 70% of the energy needed to make kraft pulp is supplied by process waste and woodwaste, while 3% is purchased electricity. In contrast, purchased energy accounts for over 40% of the energy needed to produce newsprint, and under 20% is recovered in the form of combustible wastes.

In the future, high energy costs could make Swedish newsprint uncompetitive with Canadian newsprint. Partly as a result of the Chernobyl accident, Swedish citizens have decided not to use nuclear power to generate electricity. Nuclear power in Sweden is to be completely discontinued by the year 2010, although it currently generates more than half the country's electricity supply. Two reactors are expected to be decommissioned by the mid-1990s. The official Swedish energy authority, National Energy Board, believes that by 2010, electricity prices will increase by 120%, while prices in Canada will rise only moderately.

In the pollution-control category, the mechanical pulping process avoids the need for recovering and monitoring the sulfur and chlorine now used in chemical pulping. However, the energy needed for mechanical pulping (debarking, chipping, and grinding) is almost all electricity. Mechanical pulp plants are gradually replacing sulfite pulp mills in Canada, particularly in the newsprint sector.

Newsprint can be made entirely from thermomechanical pulp, eliminating the 20% fraction of chemical pulp that formerly went into the furnish. Thermal energy required for thermomechanical pulping, like the mechanical component, is now usually supplied by electricity. In the future, the energy requirement may be met by grinders that can deliver pressurized steam generated by the grinding process itself.

CANADIAN PAPER INDUSTRY CAPITAL SPENDING ON ENERGY AND POWER PROJECTS, 1988-90*

Region	Expenditures (000 C$)	% of total energy/power capital budgets
Maritimes	30,000	4
Quebec	112,016	15
Ontario	138,724	19
Central	0	0
West	446,507	61
Total	727,247	100
% of total capital spending, all purposes	5.6%	

*Includes projects, as announced, for 1990 and beyond.
Provinces are assigned to regions as follows: Maritimes: New Brunswick, Newfoundland, Nova Scotia; Central: Manitoba, Saskatchewan; West: British Columbia, Alberta.
Source: *Pulp & Paper* Capital Spending Survey, January 1990.

CANADIAN PULP AND PAPER INDUSTRY PURCHASED ENERGY CONSUMPTION

Energy source	1972[1] joules x 10^{15}	% of total	1986[2] joules x 10^{15}	% of total	1987[2] joules x 10^{15}	% of total	1988[2] joules x 10^{15}	% of total
Coal	16.55	3.5%	5.97	1.9%	4.77	1.5%	4.85	1.5%
Petroleum products								
Residual oil	235.26	49.3	69.97	22.4	69.01	21.6	81.92	24.2
Distillates	8.71	1.8	4.96	1.6	4.72	1.5	4.76	1.4
Natural gas	95.70	20.1	80.74	25.9	85.26	26.7	97.58	28.8
Liquified petroleum gas	0.95	0.2	0.73	0.2	0.78	0.3	0.89	0.3
Other	4.92	1.0	1.50	0.5	1.65	0.5	1.40	0.4
Electricity (purchased)	115.09	24.1	148.42[3]	47.5	152.79[4]	47.9	147.09	43.4
Total	477.18	100.0	312.29	100.0	318.98	100.0	338.49	100.0

1. Reported on 1972 unit use adjusted to 1987 production.
2. Actual use.
3. 31.75 x 10^{15} joules (10.8%) used in electric boilers.
4. 32.91 x 10^{15} joules (10.3%) used in electric boilers.
Source: Canadian Pulp & Paper Assn.

Canada:

TRANSPORTATION

Transportation remains one of the significant costs in delivered prices of Canadian forest products—from 15% to 20% of the final selling price, according to the Canadian Pulp and Paper Assn. CPPA estimated the cost of shipping products from mill to market at roughly 10% of total sales.

Canada is the world's largest exporter of both pulp and paper. Estimates for 1988 show that 46.8% of pulp exports, 83.7% of newsprint exports, and 70.6% of other paper and paperboard exports were to the U.S. On a global level, Canada's woodpulp exports accounted for about 34% of the world total in 1988, and newsprint accounted for 59.8% of the world's exports.

About 574,000 railcars were loaded with forest products in 1989, down from 601,000 in 1988 and significantly lower than the 619,000 carloadings in 1987. The 1989 estimate, which amounts to about 35 million metric tons, represents approximately 16.3% of Canada's total 3.5 million carloadings, according to *Statistics Canada* data.

Pulp and paper products accounted for slightly less than 217,000 railcar loadings in 1989, down from 227,000 in 1988 and 220,000 in 1987. Pulpwood, including roundwood and chips, filled more than 185,000 railcars in 1988 but only about 175,000 in 1989.

For many years, Canada's rail system consisted primarily of two noncompetitive rail carriers: Canadian National (CN) Railway, a crown corporation, and Canadian Pacific (CP), which is privately owned. In addition, intermodal

RAILCAR LOADINGS OF MAJOR CANADIAN RAILROADS, 1978-88

(000 cars loaded)

	1989e	1988e	1987	1986	1985	1984	1983	1982	1981	1980	1979
Pulp and paper	217	227	220	217	213	211	196	191	219	227	231
Pulpwood	175	186	187	185	192	189	195	180	205	233	233
Other forest products	182	188	212	207	215	211	212	171	205	241	262
Total forest products	574	601	619	608	620	611	603	542	629	702	726
All railcar loadings	3,522	3,734	3,664	3,546	3,594	3,660	3,210	3,096	3,608	3,796	3,889
(000 metric tons)											
Pulp and paper	13,506	14,060	13,518	12,934	12,437	12,089	10,954	10,338	11,556	11,888	11,917
Pulpwood	9,734	10,489	10,487	10,590	10,806	10,574	11,102	9,960	11,157	12,563	12,550
Other forest products	11,331	11,451	12,316	11,228	11,384	11,048	10,815	8,527	9,713	10,935	11,816
Total forest products	34,571	36,000	36,321	34,752	34,627	33,710	32,871	28,825	32,425	35,386	36,283
Total traffic loaded	253,795	271,018	261,615	237,012	237,874	239,866	206,676	199,436	229,690	236,164	237,380

e = Estimate.
Source: *Statistics Canada.*

competition for pulp and paper has been much less pervasive in Canada than in the U.S., which has several competing rail lines plus various intermodal shipping systems using inland waterways and coastal sea routes.

CN experienced a considerable drop in net income in 1989 due mainly to slowdowns affecting a number of key resource sectors, including forest products. Revenues from both lumber/wood products and pulp and paper fell about 10% in 1989 compared with 1988. CP also experienced a decline in net income and revenues in 1989. CP moves about 3.0 million tons of pulp and 2.6 million tons of paper annually, or about 86,000 carloadings. Approximately 80% of the newsprint CP ships from Quebec (Canada's largest newsprint-producing province) is destined for the U.S.

Railway traffic declined substantially in 1989 after the record-breaking volumes registered in 1988 and 1987 and returned to mid-1980 levels. CN's traffic decreased by over 8.2 million metric tons, or 7.2%, and CP's was down 8.7 million metric tons, or 9.9%, due mainly to reductions in some major bulk commodities, including coal, wheat, lumber, pulpwood chips, and newsprint. This 17-million-metric-ton reduction was a result of reduced demand for rail service in all regions of the country.

Lumber traffic declined primarily because of softness in the housing market. CN's traffic was down about three times more than CP's, and CN experienced declines in the domestic, U.S., and offshore markets, while CP's traffic reductions were only in the domestic market. Movements of newsprint and other papers remained about the same for CN but declined for CP. This decline occurred mainly in traffic to the U.S., where demand for products had weakened. Woodpulp shipments showed no marked change from 1988 levels.

NEW TRANSPORT LAWS

The Canadian government implemented new transport regulations in January 1988. These regulations, affecting first the rail industry and then trucking and waterborne shipping, had several positive effects on shipments of Canadian forest and paper products.

Rail. The rail provisions contained in the National Transportation Act, 1987 are designed to benefit Canadian shippers by fostering a more competitive transportation environment and reducing regulatory burdens on railways. According to David Church at CPPA, the act has been beneficial to the pulp and paper industry in that increases in transportation costs have not been as large as they would have been otherwise.

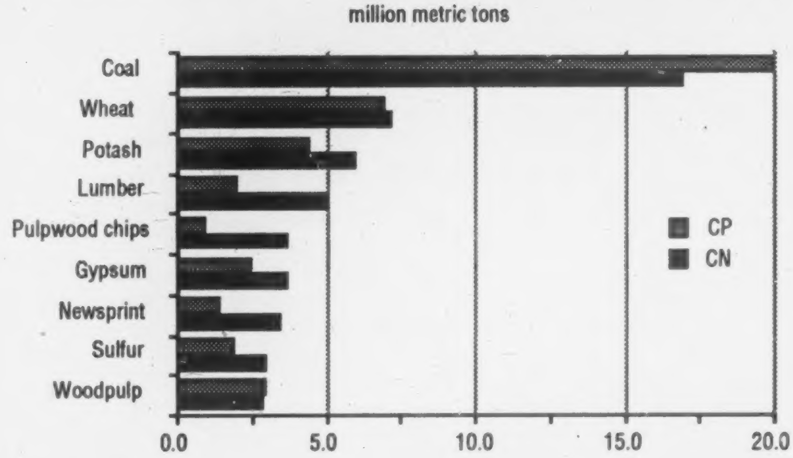
Rail is the most affected area. In order to change the noncompetitive Canadian rail system into one more like the U.S., the new laws include three key provisions:

Confidential contracts. Rates used to be set publicly, but now confidential contracts allow rail lines to tailor rates to the specific needs of shippers and to adjust rates in a timely and competitive manner. Each shipper has its own rates, which are dependent upon a particular cargo and destination as well as the bargaining strength or weakness of the carrier and its customers. The use of confidential contracts increased in 1989, as they continued to be popular with both shippers and carriers. More than twice as many contracts were signed in 1989 as in 1988, with 2,525 contracts entered by year end. CP accounted for 55% of contracts filed; CN's share stayed at 30%. The remainder were filed by CSX Transportation, Burlington Northern, Norfolk and Western, Wisconsin Central, Consolidated Rail, Algoma Central, and the Southern Railway System.

Competitive line rates. Mills on captive lines (only one of the two railroads could serve a mill) formerly paid for shipment to the cargo's destination. Under the new guidelines, shippers can ask railways to quote rates to the next interchange of carriers.

There has been little actual use of competitive line rates, with the National Transportation Agency (NTA) registering four in 1989 and one in 1988. These rates were all to connecting U.S. rail carriers for transborder traffic. Competitive line rates have, however, played a major role as a negotiating tool. Captive shippers reported that competitive line rates were important in bargaining for competitive terms and conditions and that they had a positive impact on their firms. On the other hand, railways maintained their opposi-

RAIL TONNAGE BY SELECTED COMMODITY



Source: National transportation agency of Canada (Canadian National and Canadian Pacific annual reports to agency).

tion to them. CP stated that competitive line rates are unnecessary, and CN said that actual use of competitive rates causes the benefits of one railway company's investments to be shared by its competitors.

Dispute resolution. Procedures for arbitration of shipper-carrier disputes were improved, as were public-interest appeal procedures. The law provides for legally mandated refunds when a shipper's position is upheld.

Little use was made of this provision in 1989. For rail, a total of eight public-interest investigation applications, four mediations, and one final-offer arbitration (later withdrawn) were reported. Most shippers said this provision had no impact on their firms.

The regulations also include one-year interim interchange rates in 1988 and the compilation of a database so that results of the legislation can be reviewed in 1992.

The general assessment of shippers and railways was that the rail provisions introduced by the National Transportation Act created a more competitive marketplace with confidential contracts playing a pivotal role. Railways have signed a substantial portion of their nongrain traffic to contracts, and they were able to use contracts in their efforts to achieve their goal of recapturing traffic from trucks. Shippers have managed to negotiate rate and service packages through contracts that helped them maintain or improve their own competitiveness domestically and abroad. Shippers also recognized the importance of the bargaining tools in achieving such ends.

Ocean carrier. Companion legislation was passed for truck and ocean carriers. Under the Shipping Conferences Exemption Act (SCEA), 1987, ocean-carrier conferences now have limited ability to negotiate contracts, and individual carriers are allowed more independent action. Before, rates were decided by the conferences, which were exempt from Canadian antitrust laws. These carriers haul mostly pulp and newsprint to offshore customers. The conclusion at the end of 1989 was that the SCEA had little or no effect on operations. Shippers noted their disappointment that the act still had not improved their bargaining position with conferences. Service contracts, which could be used as a potential pricing option for Canadian shippers, moved closer to extinction.

The legislation also provided for periodic review. In 1990, the NTA of Canada issued a review of the legislation's second year, concluding that transportation users were continuing to benefit from increased competition during the second year of regulation, despite the weakening economy.

"While all modes of transportation were subject to increased competitive pressures, there were differences in nature and degree. Some faced competition from other modes of transportation, while others felt competitive pressure from other companies within their own mode," the report said.

However, the report stated that conclusive judgements about the impact of transportation reforms could not yet be made because shippers are still learning how to take advantage of user-oriented provisions; carriers are still adjusting to the new competitive environment; and events outside the transportation system, such as the Free Trade Agreement, are creating different needs for Canadian users.

Trucking. The Motor Vehicle Transportation Act (MVTA), 1987 defined a new national framework regulating trucking operating outside the limits of a province or territory. Legislation in the MVTA suggests the easing of entry regulations, discontinuing of rate controls, promotion of national uniform market entry, and implementation of effective safety regulation of trucking services under federal jurisdiction. A greater degree of uniformity among jurisdictions in the application of new legislation was seen in 1989.

Developments that affected the structure of the trucking industry in 1989 followed patterns that emerged in the years leading up to reform legislation. These include territorial and market expansion, new entrants, and mergers and acquisitions.

In 1989, established carriers continued to pursue market expansion by acquiring broader operating authorities in both Canada and the U.S. While new carriers continued to enter the industry, the major source of competition came from territorial expansion and market diversification of established carriers.

The volume of applications for operating authorities in 1989 reflects a sustained level of entry in the industry. Over 30% of applicants for extraprovincial authorities were submitted by Canadian carriers based in jurisdictions other than the one in which the license was requested, indicating market expansion by established carriers. Broadly based carriers were the most active in applying for licenses, and the number of applications by U.S.-based carriers more than doubled from 1988 to 1989, from 800 to 1,819.

In the less-than-truckload (LTL) sector, little in the form of new entry occurred on a regional or national scale. Yet, the major LTL carriers were heavily involved in rationalization of operations to achieve better economies of scale.

Expansion through mergers and acquisitions was evident in virtually all regions of the country. Carrier initiatives in this area were prompted by the need for improved balance in traffic flows through greater market coverage and increased market share. This has resulted in the creation of larger trucking firms and the end of some carrier entities.

Rail lines are concerned about competition from trucking, though the transportation act does help rail compete on pricing. In addition, both the federal and provincial governments have announced more funding for highways to the obvious advantage of trucking. Competition from trucking has spurred some rail companies to develop new services, such as CP's laser service from Toronto to Chicago, Ill.

While railways maintain an advantage in long-distance travel, trucking has begun playing a larger role in shorter-distance hauls (up to 400 miles), particularly in the East, where mills are closer to market and loads often can be delivered in 24 to 48 hours. Trucking services are flexible enough to offer competitive rates and just-in-time services. Because of this, the trend over the past five or six years has been for trucking companies to move more loads.

Competition in the trucking sector appears to be on the rise. The report from NTA states that close to one-third of shippers in markets covered by extraprovincial carrier services reported an increase in the number of firms competing for their traffic, while about 63% of shippers indicated little or no change in the level of competition. There was a strong penetration by U.S.-based carriers in key transborder markets, and Ontario-based carriers continued to shift truckload operations to the U.S.

Despite the competitive atmosphere, truckload and LTL rates were generally more stable in 1989. As expected, the level of competition emerges as a key factor in rate patterns across all regions. According the the NTA review, there were fewer carriers competing for traffic; 70% of shippers reported increases in extraprovincial truckload rates compared with 45% of shippers under conditions of increased competition.

The industry is watching events with a wary eye. "A lot of what we anticipated happening is happening—it's pretty profitless out there for most guys," said A. Kenneth MacLaren, vice president-government relations for the Canadian Trucking Assn. MacLaren said he expects to see more consolidation, particularly in long-haul. "What we seem to be ending up with are four or five giant national trucker-forwarders."

Canada's experience is not the same as what happened to U.S. trucking after deregulation. It is, however, similar to what happened in Australia when that country deregulated three or four decades ago. Australia has two major trucker-forwarders, he said. The benefit is that reduced operating margins have led some carriers to implement more effective cost/pricing systems.

The trucking industry is closely watching how the provinces come to terms with vehicle weights and measures. Provincial governments agreed to a memorandum of understanding that standardizes vehicle weights and dimensions across the country, but problems still exist for interprovincial trucking.

Canadian trucking firms are at a disadvantage compared with the liberal depreciation schedules and lower fuel taxes of their U.S. counterparts, although this could change if proposed U.S. fuel tax increases go into effect. Also, the U.S. implements specific levies for highway use, while Canada's taxes are more general. Other issues will include the difference between Canadian and U.S. regulations for truck entry and the availability of equipment.

Along with this, intermodal transportation is being used more and more. With increased instances of abandonment of rail lines that are not economically sound, intermodal transportation is playing a key role in filling the gaps. Over one-third of shippers surveyed by the NTA in 1989 reported using intermodal services to move, on average, approximately one-fifth of their traffic. The growing importance of container traffic led to some major service innovations in 1989. These include CP's implementation of platform spine cars to handle ISO containers to and from eastern Canada and its announced plans for construction of a $29-million intermodal terminal near Toronto. They also include CN's new fleet of 30 high cube reefer trailers, which meet high- or low-temperature needs of moving freight, its announced expenditures of $17 million for articulated flatcars for intermodal services, and its plans to construct a $19-million terminal at Port Mann.

WATERBORNE TRANSPORTATION

Another area affected by the legislation is shipping on the Great Lakes package freight. Woodlands Marine, the sole carrier in this respect, competes with CN and CP during the Great Lakes shipping season.

Introduction of confidential contracts has put pressure on prices that Woodlands Marine charges for carrying forest products. Freight tonnages moved by Woodlands, including lumber and forest products, declined slightly in 1989, and level of service decreased slightly. Tariff levels remained unchanged. Woodlands carries lumber and forest products on its southbound main line between Thunder Bay, Ont., and lower Great Lakes destinations. The report said the use of confidential contracts by the railways kept marine freight rates stable for forest products.

Several years ago, the Canadian government announced its intention to defray transportation costs by charging carriers a portion of the costs for services such as ice breaking, navigational aids, etc. Although this affects all modes of transport, marine carriers are especially affected, according to a paper industry source. For example, mills located near tidewater, some of which use ice breakers, feel these charges would add unfairly to their costs, hurting competition between them and mills that do not use ice breakers.

The free-trade agreement between Canada and the U.S. is likely to most affect trucking. Rail traffic is coast-to-coast and involves mainly pulp and newsprint, which already are duty-free. Also, the agreement makes it easier for American trucking firms to enter the Canadian market.

The relationships between the transportation industry and the forest products and pulp and paper sectors have been warming in recent years. Although there are still disputes—or at least polite differences of opinion—most of the problems that arise are fairly small.

Shippers can take certain actions to make it easier for carriers to serve them. CP's George Morris said that for rail lines, it is important that mills release railcars quickly and in clean condition. CP also has its customers complete lengthy questionnaires, interviews individual traffic managers, and tries to improve service in response to those activities.

Harmony is further demonstrated by the fact that shippers have only occasionally taken advantage of the dispute-resolution clause of the new legislation.

Canada:

ENVIRONMENTAL SPENDING AND REGULATIONS

Environmental projects have muscled their way into the capital spending plans of Canadian pulp and paper producers with a vengeance over the past year. Estimates for environmental spending over the years 1989-91 total C$2.05 billion, up a stunning 277% from last year's predictions of $544 million for the period 1988-90, according to a January 1990 *Pulp & Paper* magazine survey.

Capital spending in the industry during 1989-91 on all types of projects is expected to be $12.87 billion, up from the $9.95 billion estimated for 1988-90. The share devoted to environmental control thus rose from 5.5% to 15.9%.

Water-pollution control is getting the most attention and has jumped 500% from the 1988-90 period to $1.59 billion in this year's survey. Solid waste disposal project costs have doubled to $70 million. And air quality spending has jumped 56% to $386 million.

Canada's environmental expenditures break down among the provinces as follows:

- Water quality: Maritime provinces, 0%; Quebec, 8%; Ontario, 10%; central provinces, 0%; West, 82%.
- Air quality: Maritime provinces, 3%; Quebec, 14%; Ontario, 1%; central provinces, 0%; West, 82%.
- Solid waste: Maritime provinces, 5%; Quebec, 54%; Ontario, 2%; central provinces, 0%; West, 39%.

British Columbia has taken the greatest share of water quality improvement efforts, which are generally part of larger projects to install modern secondary treatment systems or to cut dioxin formation through chlorine replacement.

Among British Columbian projects, MacMillan Bloedel Ltd. is spending $68 million at three bleached kraft pulp mills in the region on substituting chlorine dioxide for chlorine in the first chlorination stage and on better pulp washing. Weyerhaeuser Canada Ltd. plans to put $20 million into reducing dioxin discharges at its bleached and semi-bleached market pulp mill in Kamloops, B.C. And Skeena Cellulose Inc. is cutting dioxin output from its bleached kraft market pulp mill in Prince Rupert, B.C., at a cost of $40 million.

Canadian Pacific Forest Products Ltd. is investing $12 million at its Gold River, B.C., bleached kraft pulp mill. The money will cover a chlorine dioxide generator and lime kiln precipitator.

Fletcher Challenge Canada Ltd. is installing oxygen-enriched activated sludge treatment systems at two bleached kraft pulp mills in British Columbia, at a total cost of $130 million. The company is also spending $50 million

ANNOUNCED SPENDING PLANS FOR ENVIRONMENTAL CONTROL PROJECTS, 1989-91

(000 C$)

Region	Water	Air	Solid waste	Total
Maritimes	4,250	11,750	3,500	19,500
Quebec	125,700	53,719	37,656	217,075
Ontario	155,498	5,010	1,328	161,836
Central	0	0	0	0
West	1,306,853	315,916	27,398	1,650,167
Total	1,592,301	386,395	69,882	2,048,578
% of total pollution control capital spending	77.7%	18.9%	3.4%	100.0%

Source: *Pulp & Paper,* "Capital Spending Survey: 1989-91" January 1990.

to cut dioxin discharges from another bleached kraft pulp mill in the province.

Other regions are also taking up the battle against water pollution. Stone Container Corp. is putting $32 million into a program at its Trois-Rivières, Que., groundwood paper mill to reduce suspended solids and biological oxygen demand in effluent. Domtar Inc. announced last December that it would put $60 million into an environmental upgrade at its softwood kraft market pulp mill in Lebel-sur-Quevillon, Que. The investment will cover a scrubber to reduce particulate emissions from the bark boiler and a chlorine dioxide plant. The scrubber should be operational by the end of the year, and the plant is expected onstream by early 1992. A similar chlorine dioxide project is being considered for Cornwall, Ont.

Canadian Pacific Forest Products Ltd. will spend $36 million on a secondary effluent treatment plant at its bleached kraft market pulp and newsprint mill in Thunder Bay, Ont. The system will consist of an activated sludge system using pure oxygen and will cut down biological oxygen demand at least 90% and organic chloride discharges by about 50%.

Procter & Gamble Cellulose, Grande Prairie, Alta., announced last fall that dioxin and furan contamination in market pulp produced at its bleached kraft mill had been cut from levels of 40 ppt and 400 ppt respectively to less than 1 ppt. The plant planned to put in a $38-million chlorine dioxide generator by mid-1990 to reduce the use of chlorine. P&G plans to double the mill's capacity but is running into local opposition, and the project has been delayed for at least two years for environmental studies.

Enforcement of national water standards has been a ticklish issue. Early in 1989, environment minister Lucien Bouchard announced that many Canadian pulp mills could be charged with violating toxic discharge limits if existing regulations were enforced. A government study indicated that 83 of the country's 122 pulp mills were over the limits. Part of the trouble was blamed on the policy of varying the standards for a mill based on when it was built.

As in the U.S., dioxin has been of central interest, and Canadian producers have been scrambling to rid pulp and paper of the contaminant. For example, the manufacturers committed themselves to supplying by summer 1989 solid bleached sulfate board—used to make milk cartons—that would not transfer any detectable levels of dioxins or furans to the milk.

Last fall, the Canadian Pulp & Paper Assn. and the Pulp & Paper Research Institute of Canada (Paprican) came out with results on their measurements of dioxin contamination in pulp, sludge, and effluent at 17 pulp mills in B.C.

Organochlorine discharges found at mills with secondary treatment systems already in place averaged 3.1 kg/metric ton of pulp produced. Without the help of such systems, the contamination rose to 6.1 kg/metric ton. In pulp, dioxins ranged from nondetectable to 26 ppt, and furans from nondetectable to 5,200 ppt. In effluent, dioxin levels ranged from nondetectable to 400 ppq, and in sludge varied from nondetectable to 130 ppt. Paprican estimated that British Columbian pulp mills will have to spend more than $1 billion over the next few years in the battle against dioxin, organochlorines, and effluent toxicity. Also last year, Environment Canada took up a study of Canada's 47 bleached kraft pulp mills for dioxin in pulp, sludge, and effluent.

Dioxins and furans in mill effluent eventually will be regulated nationally under the Canadian Environmental Protection Act (CEPA), passed in June 1988, but the individual provinces have also set up their own regulations.

Alberta has especially strict environmental standards. It requires new or expanding pulp mills to extend the first delignification stage, use oxygen delignification, and substitute 60% to 70% of the chlorine with chlorine dioxide in the first stage of conventional bleaching.

In mid-1989, British Columbia environment minister Bruce Strachan informed the province's 17 pulp mills that

PROJECTS ANNOUNCED IN BRITISH COLUMBIA DURING 1989

Company	Mill	Project	Cost (million C$)
Canadian Pacific Forest Products	Gold River	ClO_2 generators, lime kiln precipitator	C$12
Canfor	Prince George	O_2 delignification, upgrade secondary treatment, ClO_2 generators	150*
Fletcher Challenge Canada	Mackenzie	ClO_2 generator, expand secondary treatment, screens, washer, boiler upgrade	50
	Crofton	Secondary treatment	65
	Elk Falls	Secondary treatment	65
Howe Sound Pulp & Paper	Howe Sound	ClO_2 generator, O_2 delignification, secondary treatment	88
MacMillan Bloedel	Harmac, Port Alberni, Powell River	ClO_2 substitution, washing	68
Repap Enterprises	Skeena	Secondary treatment, ClO_2 substitution	40
Western Pulp	Woodfibre	ClO_2 generators, secondary treatment, brownstock washing	70
Weyerhaeuser Canada	Kamloops	ClO_2 generators	20

* Spending for both mills in Prince George.

rely on chlorine bleaching that they would have to spend about C$800 million by 1994 to eliminate the production of toxic chemicals. Rather than discharging effluent directly into the Pacific Ocean, the mills will now have to put in secondary wastewater treatment facilities. The mills will have to meet discharge limits on chlorinated organics—including dioxins and furans—of 2.5 kg/metric ton of pulp produced by December 1991 and 1.5 kg/metric ton by 1994. Unlike Alberta, however, the province apparently will not require oxygen delignification systems.

Ontario mills are also facing greater accountability. Last year, the Ontario environment ministry notified the province's nine kraft pulp mills that they would have to sharply cut chlorinated organics discharges. And stricter regulations for the region will be forthcoming in 1991 under the Municipal/Industrial Strategy for Abatement, to be based on the best available technology that is economically achievable.

All of these different standards created a patchwork of varying regulations from province to province. To "even out the playing field" across the country, Canada set out to develop national pollution standards for pulp and paper mills.

At the turn of the year, Environment Canada warned the industry to expect new regulations on dioxin and furan discharges in effluent and strict control of other organochlorines. The new rules would also bring all mills under regulations covering discharge of suspended solids, oxygen-depleting substances, and acutely lethal toxic effluents. The regulations in effect at the time of the announcement related only to mills built after 1971.

In April, Environment Canada issued proposed standards that, if approved, would be fully implemented by 1994. The recommendations involved new regulations under CEPA and amendments to the Pulp and Paper Effluent Regulations under the Fisheries Act.

The CEPA regulations would "require modifications to the pulp bleaching process, resulting in the virtual elimination of dioxins and furans," Environment Canada said. And additional regulations might be enforced at specific sites to protect sensitive fisheries. Sale and use of woodchips containing chlorophenol and of defoamers containing higher concentrations of dioxin and furan precursors would be restricted.

The Fisheries Act update would modify effluent discharge limits through the use of new measurement procedures and would force all mills to meet standards on suspended solids, oxygen-depleting substances, and acutely lethal effluents. Although these regulations would go into effect as soon as they are approved, the agency noted that mills that would need to make alterations to meet the new standards could apply for an extension. Additional standards involving organochlorine emissions were to be developed based on the results of a report to be released later in the spring.

CPPA said the industry would be able to meet the standards at most mills but estimated the cost might be as much as $5 billion to achieve the standards by the end of 1993. The proposals were expected to go to the House of Commons early in the fall.

In spite of the attempt to make pulp and paper mills more environmentally sound, the public remains leery. Alberta has proven to be the hot seat of resistance to mill construction this year. Alberta Energy Co. Ltd.'s proposed 110,000-metric-tpy bleached chemi-thermomechanical pulp mill ran into citizen resistance over environmental issues. Though it faced a longer-than-expected environmental review process, the project was expected online late in 1990 in Lesser Slave Lake, Alta.

In some cases, the green movement is forcing business to go elsewhere. Parsons & Whittemore Inc. abandoned plans for a C$500-million bleached kraft pulp mill near High Level, Alta. The company apparently was responding to the negative publicity generated by the review of a project proposed by Alberta-Pacific Forest Industries Inc., as well as the difficulty of dealing with shifting environmental standards.

Al-Pac's environmental impact assessment for a proposed 500,000-metric-tpy bleached kraft pulp mill to be built near Athabasca, Alta., prompted the Alberta Environment Ministry to list 231 areas of concern to be addressed before a construction permit could be considered. As local opposition increased, Al-Pac declared early in 1990 that any further holdups on the approval for its revamped C$1.3-billion pulp mill proposal could force it to abandon the project. But the federal government said that the mill as designed at the time was environmentally unacceptable. Environment Canada was concerned with the effect of effluent discharge on the Peace-Athabasca Delta and the Athabasca River fishery.

After a federal-provincial review board recommended further studies before approving Al-Pac's pulp mill, Alberta Premier Donald Getty asked for a third-party panel of experts to assess the board's report.

The Alberta government eventually signed on the Finnish engineering firm Jaakko Pöyry Oy to study the review board's findings. Jaakko Pöyry's objectivity came into question after it was revealed that in 1983 the firm had recommended bleached kraft pulp mills in the Athabasca region being considered for the Al-Pac project.

Al-Pac then moved aggressively to alter the mill's design to satisfy environmental critics. The company came out with a new plan that avoids chlorine use and cuts the pollutants released in the mill's effluent down from 1.5 metric tpd to 300 kg/day. The new technology involved will be used by Swedish pulp and paper firm Korsnas starting this summer. The process makes use of extended cooking of the wood fiber, oxygen bleaching, chlorine dioxide substitution, hydrogen peroxide, and recycling of water treatment bacteria. Although Al-Pac had previously been concerned that it would need to use chlorine to complete the removal of lignin from the pulp, research developments and Korsnas's decision provided Al-Pac with evidence that it could eliminate the use of chlorine.

In the midst of Al-Pac's fight, dioxin contamination in fish in the province was found for the first time to be above federal standards for safe consumption, according to information in a confidential federal report obtained by the *Edmonton Journal*. A fillet sample from one fish out of fifteen tested from the Athabasca and Wapiti rivers contained more than the 20 ppt limit on dioxins and furans; levels of the contaminants in two other whole-fish samples were also high. Scientists urged that further tests be done to show the result was not an anomaly and suggested that health warnings should go out for fish-eaters.

Al-Pac said that the new findings on dioxin contamination in fish should have no impact on its proposed mill, since it would not release detectable levels of dioxin. However, after the fish study became public, Alberta announced that Al-Pac's modified project would have to undergo public review. Environment Minister Ralph Klein said an independent, three-person review panel would conduct the public hearing and also consider the technical aspects of the project.

If Al-Pac can prove its discharges will meet expectations, the Federal Dept. of Environment said it would be satisfied. But scrutiny of Al-Pac's business will not end with the mill review. The firm's timber-cutting plans now must also go before the public.

Daishowa Canada Co. Ltd., meanwhile, has been contending with delays on its $500-million bleached kraft pulp mill near Peace River, intended to go online this summer. Though the mill was under construction, suits challenging the firm's timber license validity and calling for a federal environmental review of the project were expected to set back the startup date. But in mid-1990, a federal court justice indicated hearings could not be held until a judge was available. That would not happen before September at the earliest, so the plant was thus expected to go onstream before the various suits against Daishowa could be settled. The project then gained a provincial license to begin operations in the summer. Though Klein came under fire for issuing the license, he noted that the mill satisfied all requirements of Alberta Environment, including dioxin and furan limits.

Celgar Pulp Co. also will face a review of a proposed expansion in Castlegar, B.C. If given the go-ahead, the $630-million project will more than double bleached kraft softwood pulp capacity to 420,000 metric tpy. Last October, the company was projecting a mid-1992 startup. Celgar will have to place the plan before a federal-provincial environmental review panel—the first such review for a British Columbian pulp mill. The panel reportedly will concentrate on air and water quality, wood chip supply sources, and the impact of greater truck traffic.

Environmental control measures have not been restricted to Canadian provinces. Tree death in Canada brought about by acid rain has become an international issue because the nation claims that half its acid rain originates in the U.S. Although the U.S. has not been particularly forward in following up on a pollution-control commitment made during the Carter administration, it has now agreed to begin talks with Canada on an acid rain pact this summer.

Paper:

INTRODUCTION

Paper grades are generally classified according to overall end use, creating five broad groupings: 1) newsprint, 2) printing papers, 3) fine or writing papers, 4) packaging and converting papers, and 5) tissue papers. Newsprint is not included with other printing and publication papers because it is a more basic product and because newsprint mills have fewer value-added systems such as coaters or supercalenders than printing paper mills. Newsprint is the crudest and least expensive publication paper.

Paper grades are further classified by fiber content and other manufacturing factors and by even more specific end uses. Constantly evolving papermaking technology and an increasing array of furnish and fillers create a changing classifications landscape. In addition, some paper and paperboard grades are so similar that classification by end use takes on more importance.

Factbook relies on classifications established by the U.S. Bureau of the Census and those used by the American Paper Institute and the Canadian Pulp & Paper Assn. These classifications are divided into uncoated free-sheet or wood-free, consisting mainly of fine writing papers and a large volume of printing papers; coated paper, used almost exclusively for publishing and commercial printing; and uncoated groundwood paper, also known as wood-containing or mechanical. Both coated and uncoated groundwood grades are used for magazines, catalogs, and newspaper inserts. In fact, the top-end uncoated groundwood papers—the high-filled supercalendered grades—follow the market for the low-end lightweight coated (groundwood) papers. However, low- and mid-range uncoated groundwood papers (such as rotonews and machine-finished offset) are usually priced substantially below coated groundwood.

Uncoated and coated free-sheet grades are made with little or no mechanical (groundwood) pulp. Included in the uncoated free-sheet category is cotton-fiber paper, a small part of the fine papers group. Groundwood papers are often made with stone groundwood or thermomechanical pulp. *Factbook* looks at the eight major subgroupings that are commonly understood and accepted by the paper industry:

- Newsprint
- Uncoated groundwood (mechanical) papers
- Coated papers
- Uncoated free-sheet (wood-free) papers
- Cotton-fiber papers
- Bristols
- Packaging and industrial converting papers
- Tissue.

Each grade segment is examined in individual chapters that detail production and market distinctions within these categories, along with important trends in production techniques or end uses.

These paper grades are most commonly produced on fourdrinier paper machines or with twin-wire formers, but in a few cases, cylinder board machines or multi-ply formers are used. Although paper machines come in many sizes, the trend has been toward larger units, some rated at nearly 400,000 tpy, as opposed to many older machines at 150,000 tpy or less. Machine configurations depend upon the dominant grade of paper to be produced or a paper mill's particular requirements for its own product, dictated by location, end use(s), or other factors.

Papermaking begins with a slurry of fibers and water that is drained (dewatered) on a wire, with further excess water removed by pressing and drying. The dried sheet is then wound on a reel from which rolls or sheets of paper are produced.

Papermaking is a complex process, combining sophisticated and evolving technology and decades of experience. No two mills make the same grade of paper by exactly the same method or with the same equipment. For example, newsprint can be manufactured on a twin-wire former using 100% wastepaper, or a similar-quality newsprint can be produced on a fourdrinier machine using groundwood pulp. Some paper mills are modern, using the most up-to-date, large-scale equipment available, whereas other paper mills make similar grades on small equipment at 100-year-old sites. Many older machines are being rebuilt, or they or whole mills are being mothballed because they no longer provide adequate return on investment.

Factbook provides the reader with an overall introduction to the most important sectors of the paper industry, with discussions elsewhere in the book of important themes for the entire pulp, paper, and paperboard industry. More technical and detailed reference books exist for those who wish to pursue such study.

U.S. PRODUCTION AND CAPACITY FOR PAPER GRADES

(000 short tons)

	Production[1]		Capacity[2]		
Year	Tonnage	Change (%)	Tonnage	Change (%)	Utilization rate (%)
1992e	43,975	5.0%	45,600	2.8%	96.4%
1991e	41,881	4.6	44,342	4.0	94.4
1990e	40,026	5.0	42,649	3.2	93.8
1989p	38,133	-0.4	41,326	2.8	92.3
1988	38,298	3.9	40,211	2.9	95.2
1987	36,876	5.8	39,080	2.8	94.4
1986	34,859	5.1	38,014	1.2	91.7
1985	33,179	0.6	37,581	1.3	88.3
1984	32,989	9.4	37,106	4.0	88.9
1983	30,151	-0.9	35,675	2.8	84.5
1982	30,422	2.0	34,696	2.9	87.7
1981	29,816	-1.5	33,706	3.2	88.5
1980	30,281	2.4	32,659	4.7	92.7
1979	29,580	4.7	31,179	2.4	94.9
1978	28,253	0.6	30,460	2.1	92.8
1977	28,096	5.6	29,831	2.1	94.2
1976	26,612	14.2	29,210	1.0	91.1
1975	23,306	-12.6	28,922	1.4	80.6
1974	26,651	0.6	28,532	3.3	93.4
1973	26,483	4.1	27,621	1.7	95.9
1972	25,435	6.8	27,156	3.4	93.7
1971	23,811	0.8	26,270	1.8	90.6
1970	23,625	0.1	25,806	2.2	91.5
1969	23,596	—	25,257	—	93.4
Average 1970-92		2.9%		2.6%	

e = Estimate.
p = Preliminary.
r = Revised.

1. Bureau of the Census data. Includes newsprint, printing/writing, packaging and industrial papers, and tissue.
2. American Paper Institute.

PUBLICATION PRINTING TECHNOLOGY PROCESS CHANGES: 1989-91*

	1989	1990e	1991e
Offset	78%	79%	80%
Gravure	22	21	20

*Percentage of use by magazine publishers.
e = Estimate.
Source: Magazine Publishers of America, "Paper Outlook."

CANADIAN PRODUCTION AND CAPACITY FOR PAPER GRADES

(000 short tons)

	Production[1]		Capacity[1]	
Year	Tonnage	Change (%)	Tonnage	Change (%)
1989	15,272	-0.4%	16,577	5.7%
1988	15,331	4.1	15,677	3.0
1987	14,722	5.3	15,225	2.0
1986	13,986	5.0	14,921	3.2
1985	13,298	2.6	14,458	1.3
1984	12,965	3.4	14,270	0.9
1983	12,536	6.5	14,149	1.9
1982	11,772	-6.9	14,012	3.8
1981	12,640	3.6	13,502	4.0
1980	12,200	-0.5	12,975	0.9
1979	12,259	0.9	12,855	2.0
1978	12,148	9.0	12,603	0.9
1977	11,146	3.6	12,493	0.8
1976	10,757	17.1	12,396	1.0
1975	9,186	-22.0	12,275	0.9
1974	11,782	6.0	12,168	-1.0
1973	11,120	3.9	12,292	1.4
1972	10,700	4.7	12,121	—
1971	10,215	-1.4	—	—
1970	10,357	-0.1	—	—
1969	10,372	—	—	—

1. Includes newsprint, groundwood printing and specialties, book and writing (uncoated woodfree and coated after 1987), kraft, tissue, and special; excludes building papers.
Source: Canadian Pulp & Paper Assn.

ESTIMATED NUMBER OF MACHINES AND TOTAL CAPACITY IN U.S.—1975 AND 1989

	1989r		1975	
	Number	Annual tpy (000 tons)	Number	Annual tpy (000 tons)
Total paper	858	41,326	981	28,922
Newsprint	42	6,280	38	3,848
Printing/writing and related	426	23,811	475	14,274
Packaging/industrial converting	178	5,472	228	6,368
Tissue	212	5,762	240	4,432

r = Revised.
Source: American Paper Institute capacity surveys.

U.S. SHIPMENTS[1] OF PAPER GRADES, 1976-89

(000 short tons)

	1989	1988r	1987	1986	1985	1984	1983
TOTAL, ALL GRADES	38,074	38,006	36,199	35,510	33,179	32,989	32,205
PRINTING/WRITING AND RELATED PAPERS	27,879	27,949	26,691	25,448	23,861	23,925	22,662
Newsprint	6,024	5,913	5,831	5,638	5,503	5,620	5,266
Uncoated groundwood paper	1,764	1,647	1,544	1,574	1,564	1,723	1,604
Publication and printing	1,465	1,366	1,363	1,354	1,361	1,488	1,383
Supercalendered[2]	446	384	(D)	(D)	(D)	345	394
Other	1,019	982	1,000	1,016	1,004	1,143	989
Other converting and miscellaneous	152	139	(D)	(D)	(D)	(D)	(D)
Body stock for coating	—	—	(D)	(D)	(D)	(D)	(D)
Coated printing and converting paper	7,544	7,612	7,064	6,521	6,036	6,469	5,852
Coated groundwood (more than 10% groundwood)	4,151	4,090	3,861	3,598	3,384	3,708	3,526
Coated one side	—	—	(D)	(D)	(D)	(D)	(D)
Coated two side	—	—	(D)	(D)	(D)	(D)	(D)
Coated free-sheet (10% groundwood or less)	3,393	3,523	3,203	2,923	2,651	2,761	2,326
Coated one side	581	592	480	482	582	580	472
Coated two side	2,812	2,931	2,723	2,441	2,069	2,181	1,853
Prime coated stock for coating	—	—	—	—	—	(S)	(S)
Uncoated free-sheet (10% groundwood or less)	10,870	11,117	10,777	10,303	9,454	8,726	8,572
Writing (chemical woodpulp)	6,314	6,312	5,934	5,606	5,299	4,992	4,837
Bond and writing, including protective check	3,075	2,936	2,698	2,437	2,316	2,247	2,142
Forms bond in rolls	1,980	2,038	2,017	2,050	1,901	1,744	1,663
Ledger	60	63	63	69	66	62	62
Mimeograph (all woodpulp furnishes)	25	28	32	85	76	81	84
Gelatin and spirit process duplicating	31	39	52	144	158	161	191
Papeterie and wedding	51	43	47	47	50	55	47
Body stock for communication, copying	347	337	334	283	237	246	203
Other technical and reproduction	344	369	376	172	176	156	123
Tablet	342	396	266	267	264	185	274
Other (onion skin, manifold, etc.)	60	63	61	53	55	55	49
Publication and printing	2,714	2,858	2,950	2,852	2,472	2,342	2,193
Plain (MF, EF, antique, bulking, SC)	324	336	334	334	266	286	265
Offset	1,786	1,889	2,011	1,909	1,622	1,551	1,448
Other publication and printing	604	634	606	609	584	504	480
Cover and text papers	450	447	411	367	378	386	372
Other converting and miscellaneous	1,392	1,500	1,481	1,479	1,305	1,006	1,170
Envelope (white woven)	732	772	713	714	666	668	627
Kraft envelope, bleached and brown	364	388	374	376	354	(D)	350
Coating basestock	296	340	394	390	—	—	—
Bleached bristols[3]	1,252	1,218	1,091	973	897	940	928
Tabulating card stock	—	—	(D)	(D)	(D)	68	107
Tag and file folder	438	430	414	389	363	356	364
Tag	201	203	207	212	200	214	215
Folder	237	226	207	178	164	141	149
Other uncoated (index, printing, postcard)	339	345	325	295	268	215	240
Coated	475	443	352	289	266	302	217
Cotton-fiber writing paper and thin paper	425	442	383	439	408	447	440
Writing, cotton-fiber	163	161	121	168	145	144	160
Bond and writing	133	135	94	131	126	125	131
Other	30	26	27	36	19	19	29
Thin paper	262	281	262	271	262	303	280
Carbonizing free from groundwood pulp	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other[4]	(D)	(D)	(D)	(D)	(D)	(D)	(D)

Continued

U.S. SHIPMENTS[1] OF PAPER GRADES, 1976-89 (continued)

(000 short tons)

	1982	1981	1980	1979	1978	1977	1976
TOTAL, ALL GRADES	30,151	29,816	30,164	29,580	28,506	28,906	26,534
PRINTING/WRITING AND RELATED PAPERS	20,986	20,791	20,362	19,271	18,482	17,923	16,784
Newsprint	5,063	5,253	4,660	3,778	3,489	3,525	3,526
Groundwood paper, uncoated	1,499	1,428	1,538	1,800	1,569	1,588	1,460
Publication and printing	1,299	(D)	—	—	—	—	1,301
Supercalendered[2]	248	(D)	156	161	324	334	—
Other	1,046	1,073	1,138	1,420	1,030	1,086	—
Other converting and miscellaneous	(D)	200	—	—	215	168	158
Body stock for coating	(D)	(D)	243	220	(D)	(D)	(D)
Coated printing and converting paper	5,224	4,775	4,751	4,580	4,513	4,215	4,063
Coated groundwood (more than 10% groundwood)	3,115	2,646	—	—	—	—	—
Coated one side	(D)	77	123	118	—	—	—
Coated two side	(D)	2,568	2,572	2,307	—	—	—
Coated free-sheet (10% groundwood or less)	2,109	2,129	—	—	—	—	—
Coated one side	450	455	356	364	477	439	—
Coated two side	1,65[illegible]	1,674	—	—	—	—	—
Prime coated stock for coating	(S)	(S)	1,700	1,791	4,036	3,776	(D)
Uncoated free-sheet (10% groundwood or less)	7,890	7,965	8,008	7,655	7,315	7,036	*
Writing (chemical woodpulp)	4,451	4,485	4,066	3,815	3,589	3,524	3,094
Bond and writing, including protective check	1,946	1,813	1,616	1,447	1,415	1,322	1,255
Forms bond in rolls	1,535	1,555	1,327	1,330	1,179	1,191	911
Ledger	60	99	107	117	63	67	64
Mimeograph (all woodpulp furnishes)	80	102	98	88	103	119	109
Gelatin and spirit process duplicating	164	178	301	234	196	166	166
Papeterie and wedding	49	61	48	62	55	48	50
Body stock for communication, copying	174	238	356	307	169	171	145
Other technical and reproduction	115	141	122	126	157	153	153
Tablet	269	221	315	299	219	203	225
Other (onion skin, manifold, etc.)	59	77	91	109	250	286	231
Publication and printing	2,064	2,206	2,127	2,048	2,199	2,082	1,904
Plain (MF, EF, antique, bulking, SC)	217	342	(D)	(D)	201	147	154
Offset	1,393	1,443	1,930	1,837	1,987	1,921	1,737
Other publication and printing	454	421	(D)	(D)	—	—	—
Cover and text papers	353	272	263	280	219	196	178
Other converting and miscellaneous	1,022	1,002	(D)	(D)	1,308	1,234	1,070
Envelope (white woven)	575	547	620	659	609	623	588
Kraft envelope, bleached and brown	304	295	272	205	212	195	—
Coating basestock	—	—	—	—	—	—	—
Bleached bristols[3]	879	904	941	957	1,127	1,108	1,041
Tabulating card stock	123	153	202	217	311	338	354
Tag and file folder	316	311	285	310	313	280	247
Tag	191	176	196	199	214	191	163
Folder	125	135	89	112	99	90	84
Other uncoated (index, printing, postcard)	234	209	222	188	239	232	228
Coated	205	231	232	242	264	258	211
Cotton-fiber writing paper and thin paper	430	466	464	502	469	450	**
Writing, cotton-fiber	134	113	131	130	119	111	103
Bond and writing	116	90	93	91	86	92	76
Other	17	23	7	7	8	7	5
Thin paper	297	353	333	371	350	339	345
Carbonizing free from groundwood pulp	(D)	(D)	196	238	224	212	198
Other[4]	(D)	(D)	137	134	126	127	148

Continued

U.S. SHIPMENTS[1] OF PAPER GRADES, 1976-89 (continued)

(000·short tons)

	1989	1988r	1987	1986	1985	1984	1983
PACKAGING AND INDUSTRIAL CONVERTING PAPER	4,744	4,875	4,624	4,643	4,697	4,976	5,097
Unbleached packaging, industrial converting	2,953	2,984	2,790	2,892	3,065	3,377	3,391
Wrapping	68	81	(D)	57	77	83	90
Shipping sack	674	734	695	673	755	816	727
Bag and sack other than shipping sack	1,658	1,609	1,512	1,648	1,712	1,951	1,860
Specialty packaging (92 lb and under)[5]	68	71	(D)	61	109	122	326
Other converting, including creping (92 lb and under)[6]	485	489	460	458	412	405	388
Packaging, industrial converting, except unbleached kraft wrapping	1,117	1,167	1,136	1,023	950	901	902
Wrapping (MG and MF butchers, miscellaneous wrapping)	50	62	47	33	33	50	65
Shipping sack, including combination kraft and rope	228	220	200	172	118	113	119
Unbleached and bleached sulfite, semibleached and bleached kraft; mixtures	213	—	191	161	108	91	95
Other shipping sack paper	15	—	9	11	11	21	24
Other bag and sack	231	229	192	204	240	209	168
Unbleached and bleached sulfite, semibleached and bleached kraft	160	160	130	142	170	137	121
Other bag and sack paper	71	69	62	63	70	72	46
Other converting (19 lb and over)	153	193	226	206	178	186	209
Waxing stock (18 lb and up)	109	126	147	148	130	132	157
Other, such as asphalting and creping stock	44	68	79	57	48	51	53
Specialty packaging	207	206	205	192	168	166	132
Glassine, greaseproof, and vegetable parchment	248	257	266	216	212	181	209
Spacial industrial paper	674	724	697	727	682	697	804
TISSUE	5,451	5,183	4,885	4,768	4,620	4,089	4,446
Sanitary paper	5,291	5,019	4,740	4,638	4,494	3,953	4,337
Toilet tissue	2,097	1,921	1,798	1,809	1,833	1,490	1,742
Single-ply	1,156	1,141	1,077	1,127	1,198	955	941
Multi-ply	941	779	721	682	635	534	802
Facial tissue, excluding toweling, napkin, and toilet	332	326	301	303	302	285	292
Napkin	699	679	626	595	596	529	594
Single-ply	519	506	432	431	451	401	467
Multi-ply	180	173	194	165	144	128	127
Toweling, excluding wiper stock	1,858	1,767	1,715	1,644	1,521	1,363	1,449
Sanitary napkin stock wadding	(D)	(D)	(D)	(D)	(D)	73	99
Wiper stock, regular, facial, and wadding type	156	186	178	156	111	109	60
Other sanitary stock	150	141	122	131	131	104	99
Tissue paper, excluding sanitary and thin	160	163	145	130	126	136	110
Wrapping tissue	77	77	69	59	56	69	(D)
Waxing tissue stock	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Creped wadding for interior packaging	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Other tissue, excluding sanitary and thin	33	36	28	23	24	31	20

Continued

U.S. SHIPMENTS[1] OF PAPER GRADES, 1976-89 (continued)

(000 short tons)

	1982	1981	1980	1979	1978	1977	1976
PACKAGING AND INDUSTRIAL CONVERTING PAPER	4,873	4,994	5,327	5,708	5,778	5,931	5,727
Unbleached packaging, industrial converting	3,308	3,586	3,718	3,911	3,872	4,061	3,917
Wrapping	85	103	137	187	210	218	201
Shipping sack	787	967	1,062	1,110	1,019	1,073	1,102
Bag and sack other than shipping sack	4,154	2,012	2,101	2,115	2,092	2,212	2,125
Specialty packaging (92 lb and under)[5]	251	165	2,074	2,085	2,064	2,182	2,076
Other converting, including creping (92 lb and under)[6]	331	340	419	499	551	558	488
Packaging, industrial converting, except unbleached kraft wrapping	828	923	1,145	1,266	1,408	1,346	1,224
Wrapping (MG and MF butchers, miscellaneous wrapping)	67	80	103	119	155	136	134
Shipping sack, including combination kraft and rope	105	118	92	102	92	107	120
Unbleached and bleached sulfite, semibleached and bleached kraft; mixtures	(D)	84	(D)	(D)	(D)	(D)	—
Other shipping sack paper	(D)	34	(D)	(D)	(D)	(D)	97
Other bag and sack	143	176	229	250	273	304	261
Unbleached and bleached sulfite, semibleached and bleached kraft	105	124	155	170	217	198	140
Other bag and sack paper	38	51	73	80	55	106	121
Other converting (19 lb and over)	183	163	251	287	264	236	407
Waxing stock (18 lb and up)	136	120	98	113	76	69	109
Other, such as asphalting and creping stock	47	42	52	59	—	—	115
Specialty packaging	124	209	269	273	365	344	—
Glassine, greaseproof, and vegetable parchment	206	177	202	234	259	219	202
Special industrial paper	737	485	464	531	498	524	586
TISSUE	4,291	4,031	4,474	4,601	4,246	4,243	4,123
Sanitary paper	4,185	3,917	4,298	4,403	4,036	4,045	3,930
Toilet tissue	1,679	1,533	1,706	1,772	1,629	1,605	1,566
Single-ply	962	944	939	978	939	877	916
Multi-ply	717	588	766	794	690	729	650
Facial tissue, excluding toweling, napkin, and toilet	277	298	370	376	383	365	359
Napkin	532	474	532	533	429	470	448
Single-ply	407	341	409	404	317	353	342
Multi-ply	125	133	123	129	112	117	106
Toweling, excluding wiper stock	1,433	1,253	1,439	1,482	1,375	1,388	1,326
Sanitary napkin stock wadding	113	116	103	98	87	73	73
Wiper stock, regular, facial, and wadding type	56	129	74	63	57	48	67
Other sanitary stock	94	114	74	78	76	96	91
Tissue paper	106	114	176	198	210	197	193
Wrapping tissue	(D)	(D)	72	63	75	74	61
Waxing tissue stock	(D)	(D)	24	31	32	28	37
Creped wadding for interior packaging	(D)	(D)	25	41	37	35	30
Other tissue, excluding sanitary and thin	21	25	18	21	29	28	30

Note: Categories shown are those now used by Bureau of the Census. Categories in older reports do not always correspond to the present ones.
r = Revised.
(D) Data withheld to avoid disclosing figures for individual companies.
(S) Suppressed because the data did not meet publication standards of the Bureau of the Census.
* "Book paper, uncoated, total." 1976—2,973,891 tons.
**"Writing and related papers, not included elsewhere, total." 1976—3,720,678 tons.
1. Reported as production by Bureau of the Census prior to 1981.
2. Forms bond included 1984 and 1985 only.
3. Excluding cotton-fiber, index, and bogus.
4. Cigarette, condenser, other.
5. Grocery bag and sack paper.
6. Other unbleached kraft bag paper.
Source: Bureau of the Census.

PRINTING/WRITING PAPER SHIPMENTS, 1981-88

(000 short tons)

Grade	1988	1987r	1986	1985	1984	1983	1982	1981
Total uncoated free-sheet[1]	11,277	10,965	10,504	9,750	9,207	8,765	7,907	7,870
Offset[2]	2,918	2,819	2,568	2,377	2,302	2,110	1,981	1,990
Copy/duplicating (BMDX)[3]	3,026	2,872	2,428	2,202	2,071	2,220	1,949	1,911
Forms bond[4]	2,127	2,157	2,135	1,911	1,805	1,700	1,569	1,569
Envelope	943	916	1,103	1,008	1,003	920	863	854
Tablet	379	425	404	435	299	400	325	322
Text and cover	349	329	276	257	265	240	230	239
Other	1,535	1,684	1,590	1,560	1,462	1,175	990	985
Total coated paper[1]	7,360	6,860	6,260	5,875	6,249	5,695	4,980	4,937
Coated one side[2]	418	456	385	369	388	405	395	430
Coated two side Nos. 1-4	3,325	3,390	2,756	2,514	2,669	2,325	1,930	1,990
Coated two side No. 5	3,617	3,758	3,118	2,993	3,192	2,965	2,655	2,517
Operating rates								
Uncoated free-sheet	95.5%	95.5%	94.4%	92.7%	91.5%	94.0%	88.0%	90.0%
Coated groundwood	95.1	91.6	91.6	89.0	94.7	95.0	84.0	91.0
Coated free-sheet	97.0	95.1	94.5	86.6	93.4	95.0	94.0	94.0

r = Revised.
1. American Paper Institute.
2. *Pulp & Paper Week* estimates.
3. Includes bond.
4. Includes carbonless.

CANADIAN PAPER PRODUCTION

(000 short tons)

Year	Newsprint	Uncoated mechanical	Uncoated wood-free	Coated	Other printing/ writing[1]	Wrapping papers[2]	Tissue/ specialty	Building papers	Total
1989	10,668	1,776	1,172	537	—	571	548	—	15,272
1988	10,989	1,628	1,023	529	1,570	623	539	—	15,331
1987	10,658	1,477	949	499	1,430	619	520	—	14,722
1986	10,238	1,346	n.a.	n.a.	1,300	596	506	142	14,127
1985	9,907	1,157	n.a.	n.a.	1,205	537	493	138	13,437
1984	9,935	1,054	n.a.	n.a.	1,122	514	198	134	12,959
1983	9,354	1,046	n.a.	n.a.	1,168	535	433	155	12,691
1982	8,947	715	n.a.	n.a.	916	499	413	137	11,627
1981	9,866	883	n.a.	n.a.	880	577	434	130	12,770
1980	9,507	677	n.a.	n.a.	987	613	416	140	12,340
1979	9,551	624	n.a.	n.a.	1,008	668	408	138	12,397
1978	9,670	580	n.a.	n.a.	871	637	390	142	12,290
1977	8,988	463	n.a.	n.a.	759	571	365	155	11,301
1976	8,915	384	n.a.	n.a.	544	580	335	165	10,923
1975	7,679	311	n.a.	n.a.	437	475	283	161	9,346
1970	8,719	289	n.a.	n.a.	616	493	240	101	10,458
1969	8,818	214	n.a.	n.a.	544	514	281	116	10,487

n.a. = Not available.
1. After 1988 broken down into uncoated wood-free and coated.
2. Kraft papers.
Sources: Canadian Pulp & Paper Assn., *Pulp & Paper*.

VALUE OF SHIPMENTS OF PRIMARY PAPER PRODUCTS

(000 $)

	1989	1988r	1987	1986	1985	1984	1983	1982	1981	1979
Newsprint	$2,952	$3,121	$2,737	$2,413	$2,393	$2,344	$2,122	$2,138	$2,187	$1,226
Uncoated groundwood	1,222	1,127	912	925	908	1,043	870	733	765	723
Publication/printing	1,024	951	809	804	832	901	—	—	—	—
Coated printing and converting	7,320	7,145	5,832	5,465	5,426	5,365	4,255	3,799	3,446	2,825
Coated groundwood	3,462	3,348	2,678	2,600	2,791	2,729	2,229	2,000	—	—
Coated free-sheet	3,858	3,797	3,153	2,865	2,635	2,636	2,026	1,799	—	—
Uncoated printing/writing[1]	9,923	9,611	8,044	7,423	6,704	6,959	5,985	5,463	5,660	4,666
Writing, chemical pulp	5,702	5,425	4,399	3,994	3,741	3,889	3,392	3,107	3,221	—
Publication/printing	2,436	2,465	2,164	2,054	1,687	1,784	1,516	1,414	1,521	—
Cover/text	672	621	531	453	468	466	362	320	277	—
Other	1,112	1,099	949	922	807	820	715	621	641	—
Cotton-fiber and thin	868	883	683	750	688	732	633	666	696	645
Bleached bristols	1,049	947	883	696	647	692	640	563	585	502
Unbleached kraft packaging[2]	1,619	1,491	1,222	1,102	1,090	1,331	1,190	1,151	1,343	1,244
Packaging and converting[3]	1,133	1,103	945	821	778	795	717	797	758	760
Special industrial	1,158	1,153	1,006	976	968	992	1,011	631	617	575
Tissue	6,058	5,139	4,571	4,213	4,593	4,019	3,977	3,679	3,550	2,618
Total[4]	33,303	31,719	26,851	24,783	24,194	24,272	21,399	19,417	19,607	15,784

r = Revised.

1. Uncoated free-sheet.
2. Plus industrial converting papers.
3. Except unbleached kraft.
4. Totals are higher than individual values due to inclusion of nonclassified grades.

Source: Bureau of the Census.

MARKET INDICATORS FOR PAPER GRADES: ESTIMATED ANNUAL U.S. ADVERTISING EXPENDITURES

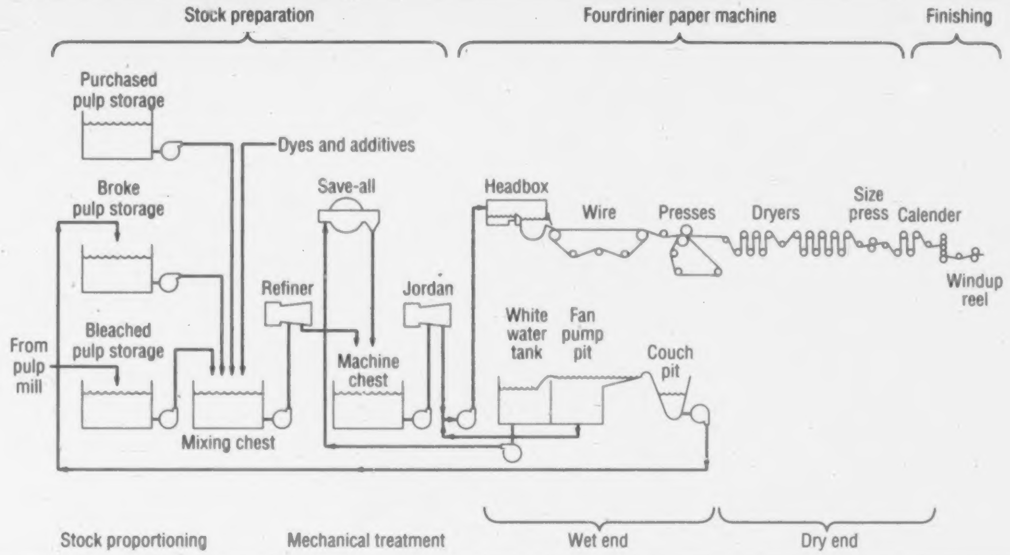
($ million)

Year	Newspaper	Magazine	Television	Radio	Direct mail	Total[1]
1989	$32,368	$6,716	$26,891	$8,323	$21,945	$123,930
1988	31,197	6,072	25,686	7,798	21,115	118,050
1987	29,412	5,607	23,904	7,206	19,111	109,650
1986	26,990	5,317	22,585	6,949	17,145	102,000
1985	25,170	5,155	20,770	6,490	15,500	95,000
1984	23,715	4,850	18,585	6,025	13,480	—
1983	20,582	4,233	16,136	5,210	11,795	—
1982	17,694	3,710	14,329	4,670	10,319	—
1981	16,528	3,533	12,650	4,230	8,944	—
1980	14,794	3,149	11,366	3,702	7,596	54,000
1979	13,863	2,932	10,154	3,310	6,653	—
1978	12,214	2,597	8,955	3,052	5,987	—
1977	10,751	2,162	7,612	2,634	5,164	—
1976	9,618	1,789	6,721	2,330	4,786	—
1975	8,234	1,465	5,263	1,980	4,124	28,000
1970	5,704	1,292	3,596	1,308	2,766	20,000
1965	4,426	1,161	2,515	917	2,324	15,000

1. Includes other expenditures.

Source: Prepared for *Advertising Age* by Robert J. Coen, McCann-Erickson.

TYPICAL FLOW DIAGRAM FOR A FINE PAPER MILL


Stock preparation
Fourdrinier paper machine
Finishing
Purchased pulp storage
Dyes and additives
Broke pulp storage
Save-all
Headbox
Wire
Presses
Dryers
Size press
Calender
Windup reel
Refiner
Jordan
White water tank
Fan pump pit
Couch pit
From pulp mill
Bleached pulp storage
Machine chest
Mixing chest
Stock proportioning
Mechanical treatment
Wet end
Dry end

MARKET INDICATORS, PRINTING AND PUBLISHING PAPERS: VALUE OF SHIPMENTS

(million $ current)[1,2]

Year	Newspapers SIC: 2711	Periodicals SIC: 2721	Book publishing SIC: 2731	Book printing SIC: 2732	Commercial printing SIC: 2751, 2752, 2754	Manifold business forms SIC: 2761
1990f	$38,226	$22,168	$15,300	$4,090	$56,525	$9,245
1989e	36,167	20,726	14,000	3,800	52,335	8,626
1988e	33,893	19,149	12,680	3,500	48,665	7,993
1987p	31,787	17,559	11,642	3,254	44,670	7,330
1986	29,091	15,719	10,732	3,102	37,358	6,985
1985	27,015	15,246	10,196	2,919	35,559	6,669
1984	25,302	14,053	9,459	2,828	33,114	6,297
1983	24,050	12,943	8,475	2,600	28,785	5,195
1982	21,286	11,525	7,723	2,392	27,091	5,034
1981	20,050	9,843	6,760	2,556	23,149	4,735
1980	17,750	9,229	6,675	2,325	19,700	4,308
1979	16,125	8,240	6,040	2,100	18,200	3,846
1978	14,500	7,292	5,495	1,920	16,500	3,259
1977	12,966	6,077	4,882	1,696	14,800	2,884
1976	11,659	5,044	3,968	1,328	13,355	2,328
1975	10,433	4,380	3,537	1,241	11,691	2,185
1970	6,967	3,096	2,434	800e	7,865	1,233

f = Forecast.
e = Estimate.
p = Preliminary.
1. Value for industry, including service.
2. Printing categories such as engraving and plate printing, greeting card publishing, blankbooks and loose-leaf binders, bookbinding work, typesetting, photoengraving, electrotyping, and platemaking services are not included but amounted to almost $7.2 billion in 1987.
Source: U.S. Dept. of Commerce: "U.S. Industrial Outlook 1989."

Paper:

NEWSPRINT

Newsprint is used primarily by newspaper publishers, with much of the remainder going to commercial printers for preprinted newspaper inserts and government printing jobs. The furnish is mostly mechanical pulp, with chemical pulp added to improve runability on paper machines and printing presses.

Most newsprint is now produced on twin-wire units, replacing the traditional fourdrinier. More than 70% of North American capacity is equipped with twin-wires. These are either new machines or existing fourdriniers that have been rebuilt with twin-wires (such as the Bel Baie, Symformer, Verti Forma, Papriformer, Periformer, or Duoformer). One way to modify a fourdrinier is through the addition of a top former, which can be installed in as little as two days.

STATISTICS FOR NEWSPRINT

	1990e	1989	1988	1987
U.S.				
Production, 000 short tons	6,475	6,088	5,982	5,842
Capacity, 000 tons	6,808	6,280	6,115	6,006
Utilization rate, %	95.1	96.9	97.8	97.3
Apparent U.S. consumption				
000 tons	13,559	13,494	13,498	13,562
lb/capita	108.3	108.7	109.8	111.4
000 tons/billion $ real GNP	3.21	3.26	3.35	3.52
CANADA				
Production, 000 short tons	10,506	10,626	10,847	10,615
Capacity, 000 tons	11,100	11,045	10,962	10,863
Utilization rate, %	94.6	96.2	99.0	97.7

e = Estimate.
Source: *Pulp & Paper.*

The first commercial gap-formers to be used in newsprint production were installed in the late 1960s. These were the Vertiformer I and the Bel Baie I (considered the first blade formers) and the Papriformer (considered the first roll former). In the early 1970s, hybrids of the original gap-formers, namely the Symformer and the Duoformer F, became available from European machine manufacturers.

A third generation of twin-wire forming now being built into new machines represents a quantum leap in this technology. It will allow newsprint in the nineties to be made on machines trimming at least 300 in. (7.6 m) and operating at speeds well above 3,281 fpm (1,000 mpm). In fact, machine speeds are expected to reach 5,900 fpm (1,800 mpm) by the year 2000, according to Nystrom, Lee, Kobayashi (NLK) Inc.

At the same time, newsprint quality targets will soon surpass the capabilities of slower twin-wire machines unless methods unrelated to the wet end of the paper machine are implemented (e.g., use of fillers and soft calendering).

Newsprint produced on twin-wire machines has better sheet characteristics and less two-sidedness. Twin-wires also enhance productivity, as marginal speedup often results from faster drainage on machines that have this constraint. In 1982, the startup of *USA Today*, a Gannett daily national newspaper, fostered the use of twin-wire newsprint, which enables publishers to make better use of four-color printing.

Newsprint in the U.S. usually comes in a standard basis weight of 30 lb/3,000 ft^2, or 48.8 g/m^2. In the past two years, even Champion International Corp.'s Texas mills have gone to the new standard from 28.5 lb (46.4 g/m^2). Georgia-Pacific Corp.'s benchmark is still 28 lb (45.6 g/m^2) and goes as low as 26.5 lb (43.1 g/m^2). Newsprint is available in standard basis weights as low as 24 lb (39.5 g/m^2) and as high as 35 lb (56.9 g/m^2). Prior to 1974, the standard basis weight was 32 lb (52.1 g/m^2), but it was reduced to trim costs and conserve fiber.

Because three major printing methods are used by consumers of newsprint, paper manufacturers vary sheet surface qualities, including basis weight, opacity, and brightness. However, the choice of printing methods is narrowing to two—offset and flexographic—because printing quality standards have outpaced the abilities of letterpress to compete with those methods.

In 1970, letterpress accounted for virtually all newspaper printing. By 1988, offset-printed newspapers represented 58% of total U.S. daily circulation, according to the American Newspaper Publishers Assn. (ANPA). Letterpress accounted for 31%, and combined methods were used for 11%. Data from MAN Roland Inc., a printing press manufacturer, show that of all presses installed at U.S. daily newspapers by 1989, approximately 61% were offset, 33% were letterpress, and 6% were flexographic.

ANPA reported in 1989 that orders for offset presses were running 2:1 ahead of flexo unit orders, but further development of flexographic technology could turn that figure around. Offset quality is better than flexo; however, flexo has significant cost advantages and uses water-base inks that do not rub off. Newsprint must be highly water-resistant and lint-free in order to be used on flexo presses.

Most newsprint is not sized, apart from the addition of alum at the grinders to prevent resin buildup. Fillers are generally needed, due to the high opacity of groundwood pulp. Bleaching is done with peroxides or hydrosulfites, giving a final brightness of about 55 or 60, in contrast to the 60-to-65-brightness range preferred for higher grades of uncoated groundwood paper, such as directory.

Although the furnish used for newsprint is still primarily groundwood, thermomechanical pulp (TMP) and chemithermomechanical pulp (CTMP) have become more commonplace. In many mills, TMP is used to replace some chemical pulp, which typically supplies 10% to 15% of newsprint furnish. With its longer fibers, chemical pulp makes a stronger sheet. Unbleached softwood sulfite pulps are used more commonly in Canada than in the U.S., where semibleached sulfate softwood pulp is preferred. TMP is weaker than chemical pulp but stronger than groundwood, and it costs less than chemical pulp. Secondary fiber also is used in some newsprint furnishes.

Approximately 12%—or 2 million metric tpy—of total North American newsprint capacity in 1989 used wastepa-

GROWTH OF NORTH AMERICAN CAPACITY BY AREA

(000 metric tons)

U.S.

Year	Northwest/ Midwest	South	West	Total
1992p	716	3,783	2,106	6,605
1991p	715	3,762	1,983	6,460
1990p	717	3,574	1,884	6,175
1989r	715	3,243	1,737	5,695
1988	695	3,127	1,728	5,550
1987	654	3,084	1,712	5,450
1986	648	2,967	1,700	5,315
1985	650	2,958	1,692	5,300
1984	594	3,051	1,660	5,305
1983	576	2,978	1,681	5,235
1982	584	2,940	1,606	5,130
1981	592	2,918	1,440	4,950
1980	633	2,627	1,160	4,420
1979	609	2,205	996	3,810
1978	670	2,080	960	3,710

CANADA

Year	Quebec	Ontario/ Manitoba	British Columbia	Atlantic	Total
1993p	4,510	2,605	2,100	1,835	11,050
1992p	4,500	2,550	2,020	1,830	10,900
1991p	4,445	2,425	1,900	1,830	10,600
1990p	4,300	2,150	1,870	1,750	10,070
1989r	4,458	2,068	1,758	1,736	10,020
1988r	4,537	2,066	1,631	1,711	9,945
1987r	4,498	2,076	1,608	1,674	9,856
1986r	4,390	2,060	1,595	1,755	9,800
1985r	4,404	2,040	1,630	1,650	9,724
1984r	4,305	2,090	1,710	1,605	9,710
1983r	4,452	2,045	1,770	1,620	9,887
1982	4,580	1,980	1,710	1,665	9,935
1981	4,495	1,985	1,440	1,570	9,490
1980	4,308	1,985	1,352	1,485	9,130
1979	4,251	1,972	1,395	1,445	9,063
1978	4,263	1,920	1,370	1,429	8,982

p = Preliminary.
r= Revised. (Canadian newsprint statistics were revised from 1982 onward to adjust for some supercalendered and soft-nip calendered paper, which was incorrectly classified as newsprint instead of uncoated mechanical printing paper.)
Source: Canadian Pulp & Paper Assn., Newsprint Data.

per as a raw material. Waste newspapers are deinked and added to other types of pulp or used alone. Garden State Paper Co. was the pioneer in this field. The company's flagship mill is in Garfield, N.J., and GSP's parent, Media General Inc., has interests in two other recycled newsprint mills in Dublin, Ga. (Southeast Paper Manufacturing Co.), and San Luis Potosi, Mexico. In addition, its patented process is licensed to Smurfit Newsprint's Pomona, Calif., mill and FSC Paper Co.'s Alsip, Ill., mill.

Recycled newsprint mills use furnish that consists of up to 100% deinked newspapers, which tend to be plentiful in the urban areas where mills are located. Some mills also use coated magazine stock for up to 30% of their fiber. In cases where the furnish is not totally wastepaper-based, deinked newsprint is combined with groundwood mechanical pulp or TMP. The mix varies widely according to fiber availability and the mill's specific cost structure.

The quality of recycled newsprint has improved steadily with better technology, making it comparable to or better than virgin sheets in some pressrooms. ANPA indicated in mid-1990 that after three years of testing, it had determined no significant optical or physical differences between recycled newsprint and virgin newsprint. In 1989, ANPA's Technical Dept. tested 1,861 samples of newsprint (15% of which were recycled) from various newspaper mills. In 1990, the number of samples were to be increased.

Southeast Paper claims to make a sheet that meets the high four-color printing standards of *USA Today*. Gannett began experimenting with the use of recycled newsprint for *USA Today* in 1988, probably compelled to do so by the increasing political pressure placed on publishing companies to use recycled newsprint. In 1990, it followed this up by printing *USA Weekend* on recycled newsprint from Hylte Bruk's mill in Sweden. Gannett, Knight-Ridder, and Scripps Howard are among the major newspaper publishers that have committed to using increasing amounts of recycled newsprint in the future. In 1990, ANPA asked its members to voluntarily increase their use of recycled newsprint from 14% to 28% of their total consumption by 1992.

Kenaf—a fast-growing, nonwood, fibrous plant—also is being studied as a fiber source for newsprint. Extensive studies have been done on newsprint made from kenaf by ANPA and the U.S. Dept. of Agriculture. The efforts were subsequently taken up by Kenaf International and Canadian Pacific Forest Products Ltd. KI includes the *Bakersfield Californian*, Agrifuture Inc., Bechtel Corp., Sequa Corp. and Werdell Ventures.

NORTH AMERICAN RECYCLED NEWSPRINT PRODUCERS, 1990*

Company	Mill	Capacity (metric tpy)	Recycled content
U.S.			
Augusta Newsprint	Augusta, Ga.	363,000[1]	Var.
FSC Paper	Alsip, Ill.	122,000	100%
Garden State	Garfield, N.J.	201,000	100
Golden State[2]	Pomona, Calif.	122,000	100
Manistique	Manistique, Mich.	56,000	100
Smurfit	Newberg, Ore.	357,000	50
	Oregon City, Ore.	220,000	50
Southeast	Dublin, Ga.	378,000	100
Stone Container	Snowflake, Ariz.	275,000	50
CANADA			
Atlantic Packaging	Whitby, Ont.	150,000[3]	100
Quebec & Ontario	Thorold, Ont.	306,000	50

Var. = Recycled content will vary.

Note: For deinking capacity starting up after 1990, see table "North American Deinked Newsprint Projects, 1990-94."

1. New 90,000-tpy deinking line added in late 1990.
2. Bought by Jefferson Smurfit Corp. in April 1990.
3. Includes new 136,000-tpy machine starting up January 1991.

Sources: Newsprint Information Committee, *Pulp & Paper Week*.

U.S. NEWSPRINT CAPACITY AND PRODUCTION

(000 short tons)

Year	Capacity	Production	Operating rate
30-lb weight			
1992p	7,281	—	—
1991p	7,123	—	—
1990p	6,808	—	—
1989p	6,280	6,088	97%
1988	6,115	5,982	98
1987	6,006	5,842	97
1986	5,804	5,630	97
1985	5,788	5,428	94
1984	5,851	5,539	95
1983	5,774	5,167	89
1982	5,654	5,042	89
1981	5,457	5,239	96
1980	4,836	4,672	97
1979	4,199	4,062	97
1978	4,104	3,768	92
1977	4,069	3,871	95
1976	4,014	3,736	93
1975	3,848	3,691	96
1974	3,722	3,561	96
32-lb weight			
1974*	3,889	3,690	95
1973	3,819	3,738	98
1972	3,694	3,656	99
1971	3,642	3,476	95
1970	3,533	3,464	98
1969	3,374	3,362	100
1968	3,176	3,045	96
1967	2,844	2,709	95
1966	2,545	2,483	98
1965	2,372	2,245	95

*Adjusted to 32-lb equivalent basis weight.

p = Preliminary.

Sources: Canadian Pulp & Paper Assn. and American Paper Institute.

KI originally planned to construct a 215,000-tpy mill near McAllen, Texas, by 1991, but later it decided to build a scaled-down, 30,000-tpy version of the mill at the same site. If all proceeds as planned, the mill would be operational by late 1991 or early 1992. Newsprint South Inc. is also considering adding kenaf to its TMP furnish to produce newsprint at its Grenada, Miss., mill.

In the summer of 1987, CPFP produced about 85 short tons of newsprint from kenaf pulp at its Trois Rivières, Que., mill. The newsprint was tested at several southwestern newspapers and was considered to be stronger and whiter, requiring less ink and yielding brighter colors than regular newsprint. Because it contains no lignin, the paper will not yellow. Other advantages are lower production costs and less pollution.

INDUSTRY STRUCTURE

Canada and the U.S. together produce approximately half the world's supply of newsprint. Canada produces just under 28%, while the U.S. produces over 17%. No other nation produces more than 10%. The U.S. is the world's leading consumer of newsprint, using 38% of global supplies. The nearest rival is Japan, which consumes just over 11%.

Canada is the world's leading producer and exporter of newsprint. It consumes only about 12% of its own production; the remainder accounts for nearly 60% of global exports. Canada's leading customer is the U.S., which received nearly 79% of the newsprint exported from Canada in 1989. Canadian newsprint represented over 56% of U.S. consumption that year.

The U.S. newsprint industry contributed just over 41% of total domestic consumption in 1989, compared with 34% in 1978. At the same time, Canadian exports to the U.S. dropped to 55% in 1989 from 66% in 1978. U.S. newsprint imports from countries other than Canada advanced rapidly to 352,900 metric tons in 1987 from 67,000 tons in 1983. However, they dropped to 275,000 tons in 1988 and 201,000 tons in 1989, mainly because currency exchange rates made imports less competitive in the U.S., and U.S. domestic capacity increased, taking a greater share of the North American market from Canadian producers.

Canada still has the bulk of North American newsprint capacity, accounting for about 64% of the 15.1 million metric tons manufactured in 1989. However, the U.S. has experienced the greatest growth in capacity during the past decade. Between 1979 and 1989, U.S. capacity increased 50%, while Canadian capacity rose by only 11.2%.

Capacity increases in both countries slowed considerably in the mid-1980s to allow demand to catch up with expansion that came earlier in the decade. More older machines, particularly in Canada, have been shut down or converted to higher-value groundwood specialties in recent years.

The North American newsprint market is headed for yet another round of rapid expansion. Between 1989 and 1991, 12 new newsprint machines with 2.5 million metric tons of annual capacity will come online. Canadian newsprint ca-

U.S. CONSUMPTION OF NEWSPRINT

(000 short tons)

Year	Consumption	Shipments from			Consumer stocks[1]
		U.S.	Canada	Others	
30-lb weight					
1989	13,494	3,970	7,023	146	1,327
1988r	13,498	5,548	7,704	303	1,614
1987r	13,562	5,540	7,795	389	1,556
1986r	13,088	5,266	7,355	330	1,392
1985r	12,684	5,123	7,267	366	1,530
1984r	12,510	5,299	7,165	208	1,457
1983r	11,606	4,860	6,580	74	1,295
1982r	11,129	4,686	6,155	46	1,387
1981	11,204	4,907	6,682	41	1,628
1980	11,120	4,473	6,744	138	1,202
1979	11,240	3,970	7,023	146	967
1978	10,872	3,674	7,102	0	1,070
1977	10,232	3,737	6,341	0	1,181
1976	9,611	3,632	6,251	57	1,333
1975	9,254	3,566	5,489	33	1,004
1974	10,284	3,457	6,949	213	1,170
32-lb weight					
1974*	10,685	3,582	7,239	213	1,248
1973	10,794	3,657	6,855	381	782
1972	10,547	3,549	6,430	328	784
1971	9,835	3,307	6,146	317	1,041
1970	9,706	3,316	6,163	314	1,110
1969	9,855	3,246	6,431	293	1,017
1968	9,327	2,944	6,107	284	894
1967	9,238	2,612	6,263	283	885

*Adjusted to 32-lb equivalent basis weight.
r= Revised. (Canadian newsprint statistics were revised from 1982 onward to adjust for some supercalendered and soft-nip calendered paper, which was incorrectly classified as newsprint instead of uncoated mechanical printing paper.)

[1] Based on data from American Newspaper Publishers Assn.

Source: Canadian Pulp & Paper Assn.

pacity will move up 23.8% (2,341,230 metric tons) between 1987 and 1992, while U.S. capacity will grow by 21.2% (1,275,000 tons), according to Canadian Pulp & Paper Assn. and American Paper Institute surveys. This will bring Canadian newsprint capacity to 10.900 million tons and U.S. capacity to 7.281 million tons in 1990.

Major Canadian projects include new machines at Thunder Bay, Ont. (CPFP); Mackenzie, B.C. (Finlay Forest Industries Ltd.); and Trois Rivières, Que. (Kruger Inc.) In addition, greenfield mills are planned at Whitecourt, Alta. (Alberta Newsprint Co.); Whitby, Ont. (Atlantic Packaging Products Ltd.); Gold River, B.C. (Gold River Newsprint Ltd.); and Port Mellon, B.C. (Howe Sound Pulp & Paper Co.).

In the U.S., new machines are planned through 1991 at the following locations: Grenada, Miss. (Newsprint South Inc., a subsidiary of Mississippi Chemical cooperative); Dublin, Ga. (Southeast Paper); Usk, Wash. (Ponderay Newsprint Co., a partnership of CPFP and five publishers); Claiborne, Ala. (Alabama River Newsprint Co., a partnership of Abitibi-Price Inc. and Parsons & Whittemore Inc.); and Longview, Wash. (North Pacific Paper Co.).

In addition, at least one recycled newsprint machine is planned. Jefferson Smurfit Corp. has narrowed down selection of a site somewhere in New York state for its 250,000-metric-tpy greenfield mill. Other companies that were considering newsprint machines—not necessarily recycled—sometime in the early 1990s included Bear Island Paper Co., Ashland, Va.; Donohue Inc., Amos, Que.; Normick/Forex, Val-d'Or, Que.; Westbrook Wood Products, Medford, Ore.; Daishowa America Co. Ltd., Port Angeles, Wash.; Stora Forest Products Ltd., Port Hawkesbury, N.S.; and Cascades Inc., Port Cartier, Que. But a down cycle in newsprint markets appears to have put those plans on hold.

Observers once thought that because of the high cost of new mills and the dwindling supply of untapped forestland, Canadian capacity would be expanded incrementally or by adding machines at existing mills. This changed, though, as profits soared during the sellers' market of 1986-88, giving mills substantial cash to reinvest. On top of this, the increased pressure to use recycled fiber led virtually all producers to take a closer look at installing deinking facilities.

Recycling. Mounting concern about solid waste in major North American cities, particularly in the U.S., has inspired lawmakers to draft bills to expand markets for recycled newsprint, the logic being that more old newspapers will be diverted from the solid waste stream and into deinking plants.

Since Florida passed the first mandatory recycled newsprint usage bill in late 1988, many other states have proposed or adopted similar bills. By late 1989, California and Connecticut had passed laws requiring publishers to consume a certain portion of recycled newsprint, and Wisconsin was close to adopting its own version of those laws. In 1990, Wisconsin passed its bill and was followed that year by adoption of similar bills in Illi-

CANADIAN CAPACITY, PRODUCTION, AND SHIPMENTS OF NEWSPRINT

(000 short tons)

Year	Capacity[1]	Production	Operating rate (%)	Change in capacity	Change in production	Shipments
30-lb weight						
1990e	11,100	—	—	—	—	—
1989e	11,045	10,626	96%	83	-220	10,590
1988	10,962	10,847	99	99	231	10,736
1987	10,863	10,615	98	61	472	10,712
1986	10,803	10,143	94	83	344	10,157
1985	10,720	9,799	91	17	-30	9,809
1984	10,703	9,829	92	-193	554	9,835
1983	10,896	9,275	85	-39	349	9,224
1982	10,935	8,925	82	474	-940	8,865
1981	10,461	9,866	94	397	358	9,829
1980	10,064	9,507	94	72	-143	9,504
1979	9,992	9,651	97	131	-62	9,677
1978	9,861	9,713	98	-41	725	9,792
1977	9,902	8,988	91	-19	73	9,005
1976	9,921	8,915	90	29	1,218	8,712
1975	9,892	7,697	78	-146	-1,851	7,728
1974	10,038	9,548	95	—	—	9,597
32-lb weight						
1974[2]	10,474	9,946	95%	137	806	9,998
1973	10,337	9,140	88	37	320	9,199
1972	10,300	8,820	86	60	365	8,901
1971	10,240	8,455	83	395	-264	8,362
1970	9,845	8,719	89	170	-99	8,704
1969	9,675	8,818	91	20	787	8,797
1968	9,655	8,031	83	361	-20	8,096
1967	9,294	8,051	87	416	-368	7,968
1966	8,878	8,419	95	457	699	8,385
1965	8,421	7,720	92	147	419	7,747

e = Estimate.
1. Tonnage data for 1965-74 are based on 32-lb weight newsprint; those for 1974-77 are measured in terms of 30-lb basis weight.
2. Adjusted to 32-lb equivalent basis weight.
Source: Canadian Pulp & Paper Assn.

nois, Maryland, and Missouri (see table). Whether or not any of these states' goals can be met within the time frames mandated is questionable.

Although virtually every newsprint producer in North America has begun to consider adding or expanding recycled newsprint capacity to meet the legislated boost in demand, some of them question whether it is feasible in the long term. A deinking plant and related modifications to papermaking equipment can cost $60 million or more. Too much deinking capacity could lead to a shortage of recycled fiber. And there is disagreement over how much secondary fiber can be reclaimed, as various factors such as contamination, improper handling, and lack of consumer interest tend to limit availability.

Approximately 2 million metric tons of North American newsprint capacity contained some percentage of recycled fiber in 1989. Canada's portion of that was 16% (310,000 tons). Canadian mills will find it much less attractive to invest in deinking facilities, as the cost of getting old newspapers to remote mill sites may be prohibitive. Nonetheless, several Canadian mills are adding deinking capacity or agreeing to buy from market deinked pulp mills (see table).

A task force with members from API, CPPA, and ANPA was formed in 1989 to follow recycling issues. Several

U.S. RECYCLED NEWSPRINT LEGISLATION, BY STATE*

State	Consumption[1]		Status
	Goal	Timetable	
Arizona	25%	7/1/91	Pending
	50	1/1/2000	
California	25	1/1/91	Passed
	50	1/1/2000	
Connecticut	20	12/31/93[4]	Passed
	90	12/31/98	
Florida	50	1992	Passed
Illinois			
H.B. 3183	22	1/1/91[3]	Passed
	25	1/1/92	
	28	1/1/93	
	28	1993	
Kentucky	50	7/15/91	Pending
	75	7/15/92	
Maine	20	12/31/93[4]	Pending
	90	12/31/97	
Maryland	12	1992[2]	Passed
	40	1998	
Massachusetts	20	12/31/93[4]	Pending
	80	12/31/97	
Missouri	10	1993[4]	Passed
	50	1996	
New Jersey			
A. 627	45	1990	
	90	1992[4]	Pending
New Jersey			
A.B. 4703	45%	12/31/89	Pending
	90	1991	
New York	11	1/1/92[4]	Pending
	40	1/1/2000	
Pennsylvania	50	—[4]	Pending
Rhode Island			
H.B. 7923	20	1993	Pending
	90	1998	
S.B. 2053	10	1/1/91	Pending
H.B. 8411	50	1/1/95	
South Dakota	10	1992	Pending
	50	1996	
Vermont			
S.B. 326	25	7/1/92	Pending
	90	7/1/95	
H. 766	25	7/1/93	Pending
	90	7/1/98	
Washington			
S.B. 6338	25	1/1/92	Pending
	50	1/1/2000	
H. 2562	10	1/1/92	Pending
	30	1/1/2000	
Wisconsin	10	1992[3]	Passed
	45	2001	
W. Virginia	25	1/1/93	Pending
	80	1/1/96	

*Does not include preference purchasing provisions for government agencies. Includes states where legislation is most advanced.

[1] Applies to amount of total consumption that must be recycled-fiber based (usually 40% recycled content), unless otherwise noted. Ranges imply goals to be phased in between these dates.

[2] Goals are aggregate of recycled fiber consumed (by weight) in proportion to total newsprint used by individual publisher.

[3] Goals are aggregate of recycled fiber consumed (by weight) in proportion to total newsprint used statewide.

[4] State task force or other group has proposed voluntary guidelines.

Source: American Newspaper Publishers Assn.

more states are expected to adopt some form of recycled newsprint legislation in 1990. Kevin Grant, manager of state affairs for ANPA, said in mid-1990 that state policymakers were moving toward voluntary approaches to increasing use of recycled newsprint. At the same time, however, more states were looking at legislation to boost markets for recycled newsprint.

API also believes that voluntary agreements may be the new trend. It noted in mid-1990 that 15 proposals had "died or are being held in committee pending the outcome of negotiated voluntary agreements." At that time, such agreements had been worked out between state associations of publishers and state government officials in New York, Pennsylvania, Massachusetts, and Connecticut.

The legislative approach to recycling varies from state to state, but all bills are aimed at reducing waste and curbing garbage buildup problems. Consumers and suppliers of newsprint will be challenged to keep up with the requirements. According to ANPA's Grant, the laws follow four patterns:

1. Mandating markets, with goals set over a certain period
2. Taxing virgin materials as a disincentive to production and demand
3. Offering tax incentives to spur production and demand
4. Take-back schemes to get publishers to collect their own newspapers.

Florida, the pacesetter with these bills, has imposed on state publishers a minor tax of 10¢ for every ton of virgin newsprint used exceeding half of total consumption. The tax will rise to 50¢/ton by 1992 if certain goals are not reached. Connecticut was the first state to set goals rather than penalties for using recycled-content newsprint.

California's approach includes supercalendered (SC) and machine-finish (MF) uncoated groundwood grades along with newsprint in its mandatory consumption bill. A fine of $1,000 will be imposed for not meeting goals that top off at 50% of total consumption by the year 2000. Meanwhile, Wisconsin proposed a law late in 1989 focusing on the total amount of recycled fiber consumed as a proportion of total newsprint used statewide rather than measuring each publisher's recycled-fiber consumption.

One of the biggest concerns in 1990 was establishing a clear definition of recycled newsprint. Although many states have followed the Environmental Protection Agency's definition that includes a requirement of 40% recycled-fiber content, many publishers and newsprint mills are opposed to this blanket approach. They note that credit is not given for using lower recycled-content newsprint, even though a newspaper might use it for all consumption rather than the 50%-or-lower goals set by some states.

Upgrading capacity. Machine makeup in the newsprint industry changed considerably during the 1980s. Older, smaller machines were shut down and dismantled or converted to the production of groundwood specialties. Larger and faster newsprint units capable of producing higher-quality newsprint replaced these smaller, less efficient machines.

Between 1982 and 1991, the Canadian industry will have idled 28 newsprint machines with a total capacity of 1.375 million metric tons, according to Jim Rowland, editor of *Canadian Paper Analyst*. Closely associated with this trend are the conversions of newsprint machines to groundwood specialties, involving another 1.032 million tons. At the same time, 16 new newsprint machines with an estimated total capacity of 3.220 million

NEW NORTH AMERICAN NEWSPRINT MACHINES SINCE 1980

Company	Location	Capacity (000 short tpy)	Startup
Bear Island Paper	Ashland, Va.	175	1980
Boise Southern	DeRidder, La.	192	1980
MacMillan Bloedel	Powell River, B.C.	176	1981
Smurfit Newsprint	Newberg, Ore.	210*	1981
North Pacific Paper	Longview, Wash.	210	1981
Fletcher Challenge	Crofton, B.C.	193	1982
Fletcher Challenge	Campbell River, B.C.	193	1982
Donohue-Normick	Amos, Que.	175	1982
Quebec & Ontario Paper	Thorold, Ont.	171*	1982
Quebec & Ontario Paper	Thorold, Ont.	171*	1982
Abitibi-Price	Iroquois Falls, Ont.	209	1983
Abitibi/Augusta Newsprint	Augusta, Ga.	226	1983
Canadian Pacific Forest Products	Gatineau, Que.	175	1987
Donohue	Clermont, Que.	198	1987
Fletcher Challenge	Mackenzie, B.C.	198	1989
Gold River Newsprint	Gold River, B.C.	254	1989
Newsprint South	Grenada, Miss.	224	1989
Southeast Paper	Dublin, Ga.	237*	1989
Ponderay Newsprint	Usk, Wash.	231	1989
Alabama River	Claiborne, Ala.	243	1990
Alberta Newsprint	Whitecourt, Alta.	243	1990
Atlantic Packaging	Whitby, Ont.	165*	1991
Kruger	Trois Rivières, Que.	198	1991
Canadian Pacific Forest Products	Thunder Bay, Ont.	265	1991
Howe Sound Pulp & Paper	Port Mellon, B.C.	220	1991
North Pacific Paper	Longview, Wash.	253*	1991

*Recycled newsprint machines.
Sources: *Pulp & Paper Project Report, Pulp & Paper Week.*

MAJOR CHANGES IN NORTH AMERICAN NEWSPRINT CAPACITY, 1989-92

Company	Mill	Capacity (000 metric tpy)	Startup date	Comments
Announced				
Abitibi-Price	Alma, Que.	(55)[1]	Jan. 1989	Grade conversion
Donohue	Clermont, Que.	(40)	Feb. 1989	Paper machine shutdown
St. Raymond Paper	St. Raymond, Que.	(30)	May 1989	Mill closure
Finlay Forest[2]	Mackenzie, B.C.	180	Mar. 1989	New paper machine
MacMillan Bloedel	Powell River, B.C.	(40)	Aug. 1989	Paper machine shutdown
Gold River[3]	Gold River, B.C.	230	Nov. 1989	New paper machine
Newsprint South[4]	Grenada, Miss.	203	July 1989	New mill
Southeast Paper Mfg.	Dublin, Ga.	215[5]	Sept. 1989	New paper machine
Ponderay Newsprint[6]	Usk, Wash.	210	Nov. 1989	New mill
Stone-Consolidated	Shawinigan, Que.	(45)	Dec. 1989	Paper machine shutdown
Bowater Mersey	Brooklyn, N.S.	50	Dec. 1989	Paper machine speedup
Abitibi-Price	Kenogami, Que.	(30)	Jan. 1990	Paper machine shutdown
Abitibi-Price	Grand Falls, Nfld.	(60)	Mar.1990	Paper machine shutdown
Alabama River[7]	Claiborne, Ala.	220	July 1990	New mill
Kruger	Trois Rivieres, Que.	110[8]	Jan. 1991	New paper machine
Stone-Consolidated[9]	Grand'Mère, Que.	(70)[10]	Sept. 1990	Paper machine shutdown
Atlantic Packaging	Whitby, Ont.	150[5]	Jan. 1991	New paper machine
Alberta Newsprint[11]	Whitecourt, Alta.	220	Aug. 1990	New mill
Canadian Pacific Forest Products[12]	Thunder Bay, Ont.	60 (net)[12]	1Q 1991	New paper machine
Howe Sound Pulp & Paper[13]	Port Mellon, B.C.	200	2Q 1991	New paper machine
North Pacific Paper	Longview, Wash.	230[5]	Apr. 1991	New paper machine
Proposed				
Garden State Paper	Northeast U.S.	n.a.[5]	n.a.	New mill
Smurfit Newsprint	Northeast U.S.	255[5]	n.a.	New mill
Steinbeis Group	East U.S. or Canada	n.a.[5]	n.a.	New mill
Bear Island	Ashland, Va.	200	n.a.	New paper machine
Donohue	Amos, Que.	200	n.a.	New paper machine
Smurfit Newsprint	Newberg, Ore.	275[5]	n.a.	New paper machine
Westbrook Wood Products	Medford, Ore.	n.a.[14]	n.a.	New mill
Daishowa America	Port Angeles, Wash.	200	1992e	New paper machine
Cascades	Port Cartier, Que.	225[15]	n.a.	New paper machine
CPFP/Kenaf International	McAllen, Texas	215[15]	n.a.	New mill
Bowater	Arkadelphia, Ark.	n.a.	n.a.	New mill

*New newsprint machines.
n.a. = Not available.
e = Estimate.

[1] Conversion to directory paper.
[2] Subsidiary of Fletcher Challenge Canada Ltd.
[3] New company consisting of major shareholder Canadian Pacific Forest Products Ltd. (CPFP) and seven partners.
[4] Owned by Mississippi Chemical Co.
[5] Recycled newsprint.
[6] Partnership between CPFP and five publishers.
[7] Fifty-fifty joint venture of Abitibi-Price and Parsons & Whittemore Inc.
[8] Company-wide newsprint capacity increase will be lower due to conversion of 70,000-tpy newsprint machine at Corner Brook, Nfld., to supercalendered paper.
[9] Formerly Consolidated-Bathurst Ltd. Acquired by Stone Container Corp. in 1989.
[10] Nos. 8 and 9 newsprint machines to be shut down when groundwood papers machine starts up in mid-1990.
[11] Investor group headed by Vancouver, B.C., businessman Ronald Stern in partnership with unidentified private Canadian companies.
[12] New 240,000-tpy unit replaces two older machines.
[13] Partnership of Canfor Corp. and Oji Paper Co. Ltd.
[14] May also be partially or fully groundwood specialties.
[15] Based on kenaf fiber.

Source: *Pulp & Paper Week*, Canadian Pulp & Paper Assn.

ESTIMATED ANNUAL NEWSPRINT CAPACITY OF MAJOR COMPANIES

(000 metric tons)

Company	Canada	U.S.	Total	Capacity share (%)
Abitibi-Price	1,514	413[1]	1,927	11.8%
Canadian Pacific Forest Products	1,647	185[2]	1,832	11.2
Bowater[3]	216	934	1,150	7.0
Fletcher Challenge	1,124	—	1,124	6.9
Stone-Consolidated[4]	816	275	1,091	6.7
Boise Cascade	262	539	801	4.9
Champion International	—	784	784	4.8
Quebec & Ontario Paper	764	—	764	4.7
Kruger	754	—	754	4.6
Kimberly-Clark[5]	322	381	703	4.3
Smurfit Newsprint	—	699[6]	699	4.3
MacMillan Bloedel	574	—	574	3.5
Donohue	488	—	488	3.0
North Pacific Paper	—	476	476	2.9
Daishowa Forest Products	430	—	430	2.6
Southeast Paper Mfg	—	378	378	2.3
Rothesay Paper	322	—	322	2.0
Georgia-Pacific[7]	—	318	318	1.9
Domtar	252	—	252	1.5
Bear Island Paper	—	203	203	1.2
Garden State Paper	—	201	201	1.2
James Maclaren Industries	187	—	187	1.1
Stora Forest Industries	171	—	171	1.0
F.F. Soucy	167	—	167	1.0
FSC Paper	—	122	122	0.7
Inland Empire Paper	—	72	72	0.4
Newsprint South	—	194	56	0.3
Manistique Papers	—	56	56	0.3
James River	—	22	22	0.1

Total North American capacity (1990): 16.322 million tons*
Capacity of top five producers: 43.6%
Capacity of top ten producers: 67.0%

*Preliminary figures from American Paper Institute and Canadian Pulp & Paper Assn.

[1] Includes 64,000 tpy of 1990 projected output from new Alabama River Newsprint Co. mill (50% owned) and 349,000 tpy from Augusta Newsprint Co. mill (50% owned).

[2] Includes 185,000 tpy of 1990 projected output from Ponderay Newsprint Co. mill.

[3] Includes Catawba Newsprint Co. (51% owned) and Bowater Mersey Paper Co. Ltd. (51% owned).

[4] Includes Snowflake, Ariz., mill and former Consolidated-Bathurst Inc. mills.

[5] Includes Spruce Falls Power & Paper Co. Ltd. (50.5% owned).

[6] Includes Golden State Newsprint Co. mill, which was acquired in 1989.

[7] Acquired Great Northern Nekoosa Corp. in 1990.

Source: Newsprint Information Committee's "Newspaper and Newsprint Facts at a Glance."

tons will have been built in Canada alone.

Three world-scale newsprint machines in Canada and two in the U.S. came online during 1989, adding 1.045 million tons to North American newsprint capacity. However, three Canadian newsprint machines were shut down indefinitely during 1989—a loss of 155,000 tpy of capacity. In 1990, only two new machines were started up, both located in the U.S., adding 440,000 tpy of capacity. The same year, though, four newsprint machines were shut down for a loss of 240,000 tpy of capacity. More shutdowns were expected as the market downturn makes marginal machines unprofitable.

Added to these shutdowns were machine conversions. Abitibi-Price upgraded about 100,000 tpy of newsprint capacity to groundwood paper production at its Alma and Kenogami, Que., mills. Fletcher Challenge installed soft calendering at its Elk Falls, B.C., mill to take advantage of demand from the insert market. And Kruger converted two of its newsprint machines at Trois Rivières, Que., to supercalendered grades. (See Uncoated Groundwood chapter.)

So closely associated are groundwood specialties and newsprint that it is hard to determine capacity accurately. Some of their end uses are similar, grade descriptions are often applicable to both, and certain paper machines can make a range of groundwood-base papers.

Stone-Consolidated Ltd., for example, is building a new 180,000-tpy machine at its Grand'Mère, Que., mill to make grades ranging from standard rotogravure to SC papers. Other mills are considering a grade known as "improved newsprint," which meets *USA Today* standards. Commodity newsprint may itself be broken into at least three quality levels as technology advances and as competition intensifies over the next few years.

In soft newsprint markets, several producers dedicate standard newsprint machines to making MF grades, which usually involves running standard newsprint through more calender nips during the manufacturing process.

Likewise, end users tend to jump around in this type of market. Most noteworthy in 1988-89 was Sears, with its "every day low prices" promotional campaign. *USA Weekend* switched to newsprint from groundwood specialties, and *Parade* was also considering downgrading to newsprint.

Three options are possible when upgrading newsprint machines to groundwood specialties: change in basis weight, increase in brightness, or improvement in finish, according to Jaakko Pöyry International Oy. A cleaner, lower-freeness mechanical pulp is required to lower basis weight, and chemical pulp content must be increased to boost strength. A change in the bleaching process is often necessary as well.

Hydrosulfite bleaching is adequate with some fiber, but southern pine may require switching to peroxide bleaching, which results in higher capital and operating costs. With borderline-quality wood, it may be possible to sort out the better wood for groundwood specialties production and to reserve the lower-quality wood for chemical pulp or news-

CANADIAN NEWSPRINT AND GROUNDWOOD SPECIALTIES CAPACITY CHANGES, 1982-91

(metric tons)

	Newsprint	Groundwood specialties
Capacity 1981	9,490,000	660,000
Machine closures (1982-91)		
1982 Abitibi-Price, Grand Falls, Nfld.	35,000 (1)*	—
Stone-Consolidated, Grand'Mère, Que.	15,000 (1)	—
Quebec & Ontario Paper, Thorold, Ont.	220,000 (5)	—
1983 Abitibi-Price, Iroquois Falls, Ont.	130,000 (4)	—
Abitibi-Price, Sault Ste. Marie, Ont.	—	20,000 (1)
Stone-Consolidated, Shawinigan, Que.	40,000 (1)	—
Stone-Consolidated, Grand'Mère, Que.	15,000 (1)	—
1984 Abitibi-Price, Iroquois Falls, Ont.	50,000 (1)	—
1985 MacMillan Bloedel, Powell River, B.C.	65,000 (1)	—
Maclaren, Buckingham, Que.	160,000 (2)	—
1986 Canadian Pacific, Gatineau, Que.	80,000 (1)	—
1987 Abitibi-Price, Kenogami, Que.	—	60,000 (2)
1989 Donohue, Clermont, Que.	40,000 (1)	—
Stone-Consolidated, Shawinigan, Que.	45,000 (1)	—
1990 Abitibi-Price, Grand Falls, Nfld.	60,000 (1)	—
MacMillan Bloedel, Powell River, B.C.	65,000 (1)	—
Canadian Pacific Forest Products, Gatineau, Que.	75,000 (1)	—
Donohue, Clermont, Que.	40,000 (1)	—
1991 Canadian Pacific Forest Products, Thunder Bay, Ont.	170,000 (2)	—
Stone-Consolidated, Grand'Mère, Que.	70,000 (2)	—
Total closures	1,375,000 (28)	80,000 (3)
Increases in capacity, 1982-91		
New machines	3,220,000 (16)	370,000 (3)
Conversions to groundwood specialties	—	1,032,000
Capacity 1991	10,600,000	2,268,000

*( ) represents number of machines involved.
Source: *Canadian Paper Analyst.*

print production. The groundwood machine's stock and whitewater systems may also require separation from the rest of the mill to retain brightness.

If mill officials choose to upgrade the finish by adding a supercalender, the wood in the woodyard should be sorted to isolate fresher and whiter wood. Low-freeness pulp is also particularly important for SC paper, and careful screening is necessary. Most SC paper mills operate with two supercalenders, which may cause layout problems in an existing mill.

Troubled Canadian Industry. A study of competitiveness in the newsprint industry among Canada, the U.S. West, the U.S. South, Sweden, Norway, and Finland was conducted by Price Waterhouse Associates for 1982-83. Canada had the highest manhours and labor costs per ton of output. Capacity of the average Canadian paper machine was the lowest at 97,000 metric tpy; Swedish machines averaged 148,000 tpy. The report also found that it takes Canadian mills six manhours to produce a ton of newsprint, while Swedish mills can do it in half the time.

Canada's ranking, however, improved in later years with variations in currency exchange rates relative to the Nordic countries. In a study commissioned by Canada's Forest Sector Advisory Council, Canada's ranking in 1987 moved from highest-cost to third-lowest-cost (after delivery) producer among all the same regions, except Norway, which was excluded due to insufficient data. Canada still had the lowest average annual capacity per machine at 100,000 metric tpy, compared with the high of 176,000 tpy in Finland. Canada also had the highest labor costs and lowest energy bill in 1987.

A further update of that study for 1988 did not vary Canada's standing among the other regions in terms of overall operating costs. It did point out, however, that the Canadian industry had shifted its mechanical pulp furnish over the period 1984-88 from a makeup of 45% stone groundwood and 33% refiner/thermomechanical/chemi-thermomechanical to 36% stone groundwood, 29% TMP, and 13% CTMP. The portion of chemical to mechanical pulps used, though, did not vary in Canada during that time. This compares to a mechanical/chemical pulp ratio of 96% TMP and 4% kraft pulp in the Swedish newsprint sector, the study indicated.

The Price Waterhouse report generally showed that obsolescence plagued the Canadian newsprint industry. It noted that the productivity advantages of the other regions was due to their much higher levels of investment. However, a study completed in early 1989 by Woodbridge, Reed & Associates (WRA) found that although Canada's newsprint sector appears to be uncompetitive in the global marketplace, it actually has the high-quality fiber and low-cost power necessary to achieve low unit operating costs and top-quality paper.

Increases in Canadian newsprint capacity will be based on TMP or CTMP technologies. Costs will decrease as use of kraft pulp is reduced to 2% to 8% of total fiber. A 100% TMP sheet is also possible. Older machines will be converted, and excess kraft pulp capacity will be integrated with higher-value printing/writing grades, according to WRA.

In 1988, approximately 137 newsprint and uncoated groundwood machines were located in North America, according to Morgan Stanley. Of these machines, 66 produced less than 60,000 metric tpy, and about 40 of them were located in Canada. World-scale newsprint machines average 220,000 tpy.

Canadian newsprint machines are generally older than those in the U.S. Some date back to the 1920s and 1930s, and most are at least three decades old. Despite speedups and rebuilds, these relatively inefficient machines often cannot compete with modern fourdrinier and twin-wire paper machines. U.S. mills also have the advantage in terms of fiber and transportation costs. However, finance costs at U.S. mills are higher.

The foreign exchange rate for Canadian currency is cru-

NORTH AMERICAN NEWSPRINT INVENTORY TRENDS

(000 metric tons)

Year	Consumption (U.S.)	Year-end stocks held by all U.S. consumers	Days of supply held at year's end by U.S. consumers	Year-end stocks held by all mills in North America
1989	12,241	1,204	38	1,581
1988r	12,245	1,464	46	1,800
1987r	12,303	1,412	45	1,637
1986r	11,873	1,263	42	1,588
1985r	11,507	1,388	46	1,732
1984r	11,349	1,322	45	1,679
1983r	10,529	1,175	42	1,577
1982r	10,096	1,258	47	1,600
1981	10,164	1,478	56	1,710
1980	10,088	1,090	42	1,275
1979	10,199	877	34	1,055
1978	9,864	970	38	1,175
1977	9,281	1,070	43	1,358
1976	8,670	1,206	52	1,506
1975	8,325	903	44	1,016
1974	9,262	1,052	48	1,212
1973	9,741	753	32	953
1972	9,551	667	26	919
1971	8,922	885	38	1,226

Source: Canadian Pulp & Paper Assn.

cial in determining the competitiveness and profitability of the country's newsprint industry. For example, a 3% to 4% rise in the Canadian-U.S. dollar exchange rate in 1988 caused Canadian mills to lose nearly 40% of a $40/metric-ton price increase implemented at the beginning of the year. The same thing happened with a price hike implemented in June 1990. The Canadian dollar rose from US$0.8596 on June 29 to as high as $0.8858 by late August before dropping back to about $0.8650 by the end of third-quarter 1990.

Canadian newsprint producers have gradually lost global market share, dropping from 35.0% to 28.7% during the 1978-89 period. In addition, Canada's share loss in its biggest market—the U.S.—is expected to worsen in the early 1990s as the U.S. industry's capacity grows. However, the loss may be somewhat offset by the numerous upgrades planned for Canadian mills through 1991 and beyond, which will give Canadian producers a cost advantage more akin to U.S. producers.

Labor relations are another problem for the Canadian industry. Province-wide strikes in British Columbia and sporadic work stoppages in eastern Canada have made publishers wary of Canadian producers' long-term reliability. The Canadian Paperworkers Union represents most unionized workers throughout the country and traditionally bargains province-wide, as in British Columbia. Otherwise, it selects a target company with which to negotiate and then applies a master agreement to subsequent negotiations, as in eastern Canada.

The pattern of labor negotiations in recent years seemed to be changing. Strikes were kept to a minimum as management and labor tried harder to reconcile their differences. Canadian production losses caused by strikes were as high as 20% in 1975, but they dropped below 1% of capacity in 1985. In 1988, only 0.6% of Canadian newsprint capacity was lost as a result of strikes.

Until 1990, it appeared as though Canadian labor relations were improving. The latest evidence of this was during the previous round of talks, when strikes were averted entirely. In 1986, British Columbian mills bargained an agreement quickly and without incident. In 1987, eastern Canadian mills managed to sign a new contract only a few

ESTIMATED TOTAL MONTHLY NEWSPRINT INVENTORY HELD BY U.S. CONSUMERS

(000 metric tons/days of supply)

	1989		1988		1987		1986		1985		1984	
Month	Tons	Days	Tons	Days	Tons	Days	Tons	Days	Tons	Days	Tons	Days
Jan.	1,483	44	1,431	43	1,324	41	1,413	45	1,429	46	1,257	42
Feb.	1,452	42	1,474	43	1,360	40	1,435	44	1,489	46	1,258	41
Mar.	1,431	41	1,512	44	1,367	40	1,405	42	1,541	48	1,221	38
Apr.	1,328	40	1,519	45	1,360	40	1,409	42	1,527	47	1,194	37
May	1,292	40	1,507	46	1,323	40	1,371	42	1,482	48	1,263	42
June	1,307	42	1,544	49	1,405	44	1,360	45	1,475	50	1,430	48
July	1,317	40	1,599	47	1,472	43	1,410	43	1,521	49	1,497	48
Aug.	1,332	38	1,615	46	1,457	41	1,438	43	1,563	48	1,508	47
Sept.	1,319	37	1,626	44	1,509	41	1,451	41	1,527	45	1,478	44
Oct.	1,262	34	1,517	43	1,442	39	1,392	40	1,506	44	1,453	42
Nov.	1,197	36	1,446	44	1,358	41	1,161	39	1,448	46	1,389	45
Dec.	1,180	38	1,469	46	1,411	45	1,269	42	1,394	46	1,335	45

	1983		1982		1981		1980		1979		1978	
Month	Tons	Days	Tons	Days	Tons	Days	Tons	Days	Tons	Days	Tons	Days
Jan.	1,254	45	1,559	56	1,166	43	947	34	1,002	36	1,074	41
Feb.	1,272	45	1,634	58	1,234	44	1,036	36	1,029	36	1,084	40
Mar.	1,247	42	1,666	59	1,286	45	1,058	38	1,027	35	1,165	41
Apr.	1,230	42	1,629	59	1,311	46	1,097	40	950	33	1,130	41
May	1,177	42	1,598	62	1,312	49	1,147	43	907	34	1,156	44
June	1,258	47	1,565	62	1,395	54	1,195	47	938	37	1,207	48
July	1,262	45	1,530	57	1,462	54	1,208	45	991	37	1,194	47
Aug.	1,311	43	1,497	52	1,455	51	1,213	43	1,024	35	1,209	45
Sept.	1,293	41	1,423	48	1,460	49	1,212	40	938	31	1,195	42
Oct.	1,234	38	1,360	46	1,481	50	1,180	39	911	30	1,193	39
Nov.	1,219	41	1,328	47	1,480	54	1,092	39	881	31	1,050	37
Dec.	1,179	42	1,258	47	1,447	56	1,090	42	877	34	970	38

Source: Canadian Pulp & Paper Assn.

weeks after the expiration of the old agreement and without any work stoppages.

In 1990, however, eastern Canadian contracts came up for renewal once again, and workers were determined to gain in wages and other terms. CPU locals idled for several weeks a number of mills, including Rothesay Paper Ltd., Quebec & Ontario Paper Co., Abitibi-Price Inc., and Canadian Pacific Forest Products Ltd. In 1991, contracts come up for renewal again in British Columbia.

Newsprint demand. Newsprint consumption in the U.S. totaled 12.303 million metric tons in 1989—a slight drop from the previous year, which was 0.1% higher than the all-time high reached in 1987, according to ANPA. The strongest regional demand growth was in the South, which accounted for nearly 32.0% of total consumption by U.S. daily newspapers in 1989—up from 27.7% in 1975. Demand in the West rose to about 23.0% from 18.7% during the same period. Demand in the Northeast declined from 26.4% to 23.7%, while the Midwest turned in the worst performance, with consumption dropping from 27.2% to just over 21.0%.

Newsprint demand is best determined by the performance of the daily newspaper industry because it is by far the chief consumer of newsprint, accounting for nearly 75% of total U.S. consumption in 1989. Advertising and circulation figures are watched closely to determine how much newsprint will be consumed in a given year.

Daily newspaper circulation has been on a fairly level trajectory since the early 1970s. It declined by 0.5% in 1985 and 0.4% in 1986. It then rebounded by 0.5% in 1987 and 0.2% in 1988 but dipped by 0.7% in 1989, according to ANPA. In contrast to daily sales, Sunday circulation has steadily gained ground. It increased an average of 1.5%/year between 1980 and 1985, then took off with a 4.6% boost in 1986 and another 6.6% increase in 1987. Sunday circulation growth has slowed in recent years, though, rising a modest 0.2% in 1988 and posting just under a 1% gain in 1989.

Modest circulation growth combined with lineage gains have kept newsprint consumption growing during most of the 1980s. Overall, U.S. newsprint consumption rose at an average rate of 2.8%/year between 1980 and 1986 to 11.937 million metric tons. In 1987, the gain in newsprint consumption measured 3.0% higher and then flattened out in 1988 and 1989. Excluding 1988 and 1989, the consumption gains compared favorably with real GNP growth, averaging 2.4%/year between 1980 and 1986.

Between 1974 and 1984, U.S. newsprint consumption rose at a 2.1% compound annual rate, while real GNP advanced 2.8%. During the early 1980s, newsprint consumption appeared to be moving ahead of growth in the economy. However, in 1988, it began to trail GNP, with consumption down that year by 0.3%, while GNP rose 4.43%. In 1989, newsprint consumption was up a scant 0.04%, compared with a 3.0% rise in the economy.

Part of the problem with U.S. newsprint demand in 1988 is attributed to upheaval in the retail industry. Leveraged buyouts of R.H. Macy's, Federated Department Stores, and Allied Stores led to a cutback in national advertising. In addition, financial advertising was hurt by the stock market's

WORLD CAPACITY FOR NEWSPRINT

(000 metric tons)

Year	Canada	U.S.	Scandinavia	Western Europe (except Scandinavia)	Japan	Others	Total
1990p	10,070	6,175	4,940	4,020	3,625	7,151	35,981
1989	10,020r	5,695	4,900	3,650	3410r	7,056	34,731
1988	9,945r	5,550	4,670	3,445	3,260	6,971	33,841
1987	9,855r	5,450	4,550	3,180	2,865	6,720	32,620
1986	9,800r	5,315	4,515	3,115	2,840	6,508	32,093
1985	9,725r	5,300	4,525	2,915	2,780	6,006	31,251
1984	9,710r	5,305	4,630	2,720	2,720	6,174	31,259
1983	9,885r	5,235	4,685	2,475	2,730	5,797	30,807
1982	9,920r	5,130	4,380	2,455	2,710	6,651	30,816
1981	9,490r	4,950	4,045	2,405	2,885	5,066	28,841
1980	9,130	4,420	3,930	2,470	2,770	4,951	27,671
1979	9,065	3,810	3,860	2,405	2,710	4,586	26,436
1978	8,980	3,710	3,640	2,375	2,640	4,346	25,691
1977	8,985	3,690	3,430	2,250	2,480	4,205	25,040
1976	9,000	3,641	3,283	2,190	2,350	3,921	24,385
1975	8,974	3,582	3,088	2,506	2,296	3,526	23,972

p = Preliminary.
r = Revised.
Source: Canadian Pulp & Paper Assn., Newsprint Data.

1989 NEWSPRINT EXPORTS FROM MAJOR PRODUCING COUNTRIES

(000 tons)

	Exporters				
Major importers	**U.S.**	**Canada**	**Sweden**	**Finland**	**Norway**
EUROPE					
Austria	—	—	—	3	—
Belgium	—	3	56	42	46
Denmark	—	—	85	90	34
France	—	33	128	107	53
Germany, Fed. Rep.	—	98	387	201	133
Greece	—	—	16	32	26
Ireland	—	9	24	16	—
Italy	—	25	72	15	38
Netherlands	—	25	125	56	67
Norway	—	—	—	2	—
Poland	—	—	—	2	—
Portugal	—	3	21	13	8
Spain	—	9	67	41	36
Sweden	—	—	—	5	6
Switzerland	—	—	—	18	—
U.K.	1	312	511	282	200
U.R.S.S.	—	—	—	41	—
Other Europe	1	1	28	—	33
Total Europe	**2**	**518**	**1,520**	**966**	**680**
NORTH AMERICA					
Canada	8	—	—	—	—
U.S.	—	6,898	126	30	44
Total North America	**8**	**6,898**	**126**	**30**	**44**
ASIA/AUSTRALASIA					
Australia	—	160	—	10	13
China, People's Rep.	27	34	—	—	—
Hong Kong	43	50	6	3	3
India	—	11	18	—	1
Iran	—	2	9	4	2
Iraq	4	—	—	—	—
Israel	3	—	—	8	—
Japan	255	65	15	5	—
Korea, Rep.	15	14	—	3	—
Kuwait	15	—	—	2	—
Malaysia	32	11	2	3	7
New Zealand	—	7	—	—	—
Pakistan	8	—	4	2	—
Saudi Arabia	6	—	—	12	—
Singapore	4	22	20	4	7
Sri Lanka	2	—	—	2	—
Syria	—	—	—	4	—
Taiwan	46	57	16	1	—
Thailand	1	38	7	1	8
Turkey	11	5	20	—	—
United Arab Emirates	—	—	—	2	—
Other Asia/Australasia	7	3	49	1	43
Total Asia/Australasia	**479**	**479**	**166**	**67**	**84**
LATIN AMERICA					
Brazil	11	55	4	2	9
Colombia	5	41	—	—	—
Costa Rica	1	10	—	—	—
Dominican Rep.	—	11	—	—	—
Ecuador	3	6	—	—	—
El Salvador	4	7	—	—	—
Guatemala	3	9	—	—	—
Mexico	12	8	—	—	—
Peru	2	8	—	—	—
Puerto Rico	—	45	—	—	—
Trinidad & Tobago	—	6	—	—	—
Venezuela	5	44	—	2	—
Other Latin America	3	15	1	—	1
Total Latin America	**49**	**265**	**5**	**4**	**10**
AFRICA					
Algeria	—	6	—	—	—
Egypt	29	23	4	—	—
Libya	—	—	—	2	—
Morocco	—	6	—	—	—
Other Africa	—	—	20	4	12
Total Africa	**29**	**35**	**24**	**6**	**12**
WORLD TOTAL	567	8,195	1,841	1,073	830

Source: *Pulp & Paper International*, Annual Review, July 1990.

plunge in late 1987. Meanwhile, newspapers themselves had to deal with a 25% boost in postal rates in April 1988. And competitive advertising from magazines, television, and newer types of promotional media such as store displays and shopping carts also had an impact. These factors continued to hinder growth in newspaper ad lineage well into 1990.

Newspaper advertising revenues grew 4.3% in 1989 but were relatively flat in 1990. Through first-half 1990, they were up just 0.1% to $15.602 billion, according to data compiled by the Newspaper Advertising Bureau (NAB). The trade association indicated that the cause for virtually no growth in advertising was the sluggish economy, with little improvement in consumer spending, as well as declines in the automobile and real estate markets. While newspapers remain the leader in terms of advertising revenues, their share of total media advertising revenues has steadily contracted from 27.6% in 1980 to 26.1% in 1989.

Another trend likely to affect the long-term viability of newspapers is a steady decline in readership. Household penetration—the ratio of daily newspapers sold to number of households—dropped from 133 newspapers per 100 households in 1946 to 70 newspapers per 100 households in 1987. Each percentage-point drop in penetration correlates to a half-percentage-point loss in advertising share for newspapers.

As the volume of newsprint consumed by newspapers wanes, usage improves significantly among newspaper inserts, advertising shoppers, directories, magazines, paperback books, and free community weeklies. In 1989, these "uses other than daily newspapers" represented an estimated 25.3% of the total newsprint consumed, compared with 23.0% in 1980.

Preprinted inserts currently account for about 33% of all newspaper ad volume and 18.5% of all ad expenditures, but they bring in only about 10% of ad revenues, according to NAB. Over half of what advertisers spend on preprints goes to printers, and only 45% goes to newspapers. In a survey done by the Retail Advertising Conference in late 1988, participants said they planned to spend 55% of their 1989 ad dollars on newspapers—36.75% on ROP campaigns and 18.25% on inserts.

According to the Dept. of Commerce, over the next five years, major metropolitan newspapers may increasingly find themselves competing not only with daily and weekly suburban papers and shoppers but also with city magazines. Other threats will be increased spending by advertisers for telemarketing and television home shopping.

WORLD DEMAND FOR NEWSPRINT

(000 metric tons)

Year[1]	North America	Western Europe	Asia, Africa, Oceania	Eastern Europe	Latin America	Total*
1989	13,123	7,571	7,267	2,126	1,434	31,521
1988r	13,495	7,135	6,987	2,116	1,540	31,273
1987r	13,609	6,671	6,355	2,019	1,552	30,206
1986r	12,845	6,284	6,220	1,929	1,506	28,784
1985r	12,589	6,032	6,117	1,896	1,271	27,905
1984r	12,555	6,023	6,847	1,825	1,184	28,434
1983r	11,409	5,574	5,566	1,761	1,760	26,070
1982r	10,811	5,424	5,333	1,669	1,184	24,421
1981	11,593	5,570	5,651	1,707	1,538	26,059
1980	11,280	5,640	5,318	1,647	1,326	25,211
1979	11,075	5,355	5,166	1,694	1,192	24,482
1978	10,700	5,079	4,872	1,683	1,088	23,422
1977	9,966	4,796	4,624	1,716	1,169	22,271
1976	9,821	5,092	4,311	1,694	962	21,880
1975	9,029	4,975	4,064	1,670	924	20,662
1974	10,437	5,622	3,672	1,613	1,358	22,702
1973	10,661	5,497	3,446	1,532	1,264	22,400
1972	10,059	5,100	3,388	1,509	1,295	21,351
1971	9,517	4,979	3,263	1,467	1,285	20,511
1970	9,533	5,269	3,173	1,418	1,449	20,842
1969	9,688	5,113	2,958	1,337	1,297	20,393
1968	9,080	4,553	2,595	1,264	1,184	18,676
1967	8,887	4,222	2,355	1,200	1,084	17,748
1966	8,998	4,419	2,077	1,095	985	17,574

*Totals may not add up exactly due to rounding off of some figures.
1. Figures prior to 1974 do not include People's Rep. China.
Source: Canadian Pulp & Paper Assn., Newsprint Data.

In addition, the Bell operating companies will be a continuing challenge to newspapers as they attempt to have Congress lift electronic publishing restrictions that bar them from creating information services that would travel over their own lines. If newspapers fail to act, they will face the prospect of the phone companies being allowed to provide these services, Commerce notes in its U.S. Industrial Outlook 1990.

Newsprint prices. The industry probably has not experienced a pricing cycle as chaotic as the period from mid-1988 to mid-1989. Prices dropped by more than 8%, and discounts of 20% and higher were quoted on contract shipments. This climate was truly amazing, considering that mills were operating near capacity levels for much of the time. The market appeared to be in the grips of what some observers called "psychological factors," with both buyers and sellers acting in anticipation of the expansion cycle of 1989-91. Preselling of tonnage from new machines coming onstream was widespread, which forced existing producers to meet competitive discounts or risk losing volume.

This puzzling phenomenon was followed by another year of surprises in 1990. With profits in a tailspin—especially for Canadian mills—North American newsprint manufacturers resisted all signs pointing thumbs down to a price hike and pushed one through on June 1, 1990. This boosted list levels to US$685/metric ton in the U.S. East and to $630/metric ton in the U.S. West (see table). Then, three months later, producers began to announce plans for another price increase for Jan. 1, 1991, to $720/metric ton in the East and $665/metric ton in the West.

Newsprint is a cyclical business. Capacity surges following periods of tight supply are well known to seasoned in-

NEWSPRINT PRICES, 30-LB DELIVERED

(US$/metric ton)

	Eastern			West Coast		
Year	List	Transaction	Effective	List	Transaction	Effective
1990						
3Q	$685	$565		$630	$575	
2Q	650/685	535/565	6/1-7/1	630[1]	540/575	6/1
1Q	650	535		630	540	
1989						
4Q	650	535/540		630	540/545	
3Q	650	550/575		630	550/560	
2Q	650	575		630	560	
1Q	650	585/612		630	580	
1988						
4Q	650	600		630	590	
3Q	650	610		630	598.50	
2Q	650	610		630	598.50	
1Q	650	610	1/1-3/1	630[2]	598.50	1/1-2/1
1987						
4Q	610	570		600[3]	552.90	
3Q	610	570	7/1-9/1	600	552.90	7/1
2Q	570	553/550		570	514.50	
1Q	570	530/550		570	514.50	
Year end						
1986	570	500/550	10/1-12/30	570	514.50	10/1
1985	535	505		535[4]	508.25	
1984	535	510	7/1	500/535	508.25	3/1, 10/1
1983	500	475	9/1	468.50[5]	445	
1982	468.50	445/468.50	11/1	468.50	445	8/1
1981	470/500	490	1/1, 8/1	470/500	470	1/1, 8/1
1980	440	440/470	5/1	440	440	5/1
1979	380/413	380/413	1/1-2/1, 10/1-11/1	380/413	380/413	1/1-2/1, 10/1-12/1
1978	353	353	2/1-4/1	353	353	4/1
1977	336	336		331	331	
1976	314/336	314	3/1, 11/1-12/1	331	331	7/1
1975	287	284	1/1	309	309	1/1
1974	259	259	7/1	270	270	8/1
1973	199/206/235*	220	2/1, 6/1, 11/1	197/235	197/235	1/1, 9/1-12/1
1972	194*	182	2/1	192	192	1/1
1971	188*	176	4/1	182	182	1/1
1970	179*	168	1/1	173	173	1/1

*Prices are for paper made by Canadian mills; prices in these years for southern-manufactured paper are generally about $2 lower. Effective dates for Canadian and southern mills are generally the same, except for 1972, when southern price took effect a month later on 3/1.

1. Discount of 5% dropped effective 6/1/90, eliminating all general discounts.
2. Discount of 3% dropped effective 1/1/88, leaving a 5% discount.
3. One previously implemented 5% discount reduced to 3%, effective 7/1/87.
4. A second 5% discount added by West Coast producers, effective 10/1/85.
5. West Coast producers announced 5% discount from list, effective 7/1/83.

Sources: American Newspaper Publishers Assn., *Pulp & Paper Week*.

dustry observers. The last great capacity surge began in late 1979 and ended in early 1983. The next four years were virtually flat. But between late 1987 and early 1988, newsprint profits soared, and companies began spending their available cash. The anticipation of future excess capacity eroded prices as early as March 1988—a year before startup of the first new newsprint machine. This down cycle should last through 1992, with possible episodes of firming caused by labor strife, machine shutdowns, or other unforeseen circumstances.

Normally in soft markets, when demand is low and supplies are plentiful (such as in the early 1980s), prices either flatten or decline. Prior to the 1980s, North American newsprint prices were dominated by the actions of a few Canadian producers, generally called "the club" by U.S. publishers. A combination of rapid capacity expansion in North America and unusually strong North American currencies produced a surplus of U.S. and Canadian tonnage available for sale in the U.S. In addition, an influx of paper from previously less important sources such as Scandinavia, continental Europe, Latin America, and South Africa helped lead to the club's demise.

EXPORT PRICES FOR NEWSPRINT IN SELECTED MARKETS

(per metric ton)

	Canada to U.K.[1]		Finland to U.K.[2]	
	C$	US$	£	US$
1990				
3Q	C$702.92[3]	US$611.23	£450*	US$720.00
2Q	628.10	539.14	425*	695.30
1Q	661.12	564.96	425*	698.19
1989				
4Q	594.60	513.56	425*	682.34
3Q	623.03	528.75	425*	690.71
2Q	661.76	552.25	425*	658.84
1Q	723.42	606.29	425	717.74
1988				
4Q	733.07	614.63	425	769.04
3Q	753.80	619.34	425	716.34
2Q	763.23	629.36	400/425	705.09
1Q	698.56	566.05	400/425	775.42
1987				
4Q	670.06	515.51	400*	748.60
3Q	657.92	502.57	400*	651.88
2Q	677.75	509.13	400*	644.00
1Q	656.03	502.67	365*	585.83
1986				
4Q	621.50	450.20	365*	538.19
3Q	674.25	485.60	345	500.25
2Q	563.05	406.04	345	527.95
1Q	603.07	431.60	345	512.43
Year end				
1985	622.79	445.65	345	498.35
1984	489.17	370.19	321	371.24
1983	527.75	424.10	300	435.18
1982	606.44	493.28	300	484.35
1981	615.37	518.91	300	572.40
1980	631.44	528.53	270	643.95

*Discounting from list prices reported.
n.a. = Not available.
[1] F.o.b. point of lading, 30-lb.
[2] Delivered to U.K. pressroom, 48.8-g/m^2.
[3] For July only.
Sources: *Statistics Canada*, *Pulp & Paper International*.

From 1981 until 1986, prices vacillated but remained virtually flat for the period due to deep discounting. Price increases were attempted at the same time that publishers were offered special cuts. After several failures to raise list levels in the mid-1980s, posted prices were successfully boosted during fourth-quarter 1986.

Newsprint producers pushed through a $35/metric-ton price increase in late 1986 for a new list of US$570 in the eastern U.S. Another price increase in July 1987 raised list prices to $610 in the East and $600 in the West. On Jan. 1, 1989, producers implemented a $40 hike to $650 in the East and a $30 boost to $630 in the West.

Actual price increases were even larger as producers tightened up on discounts that had driven down transaction prices in 1986 to around $470 to $480/metric ton. Spot sales by both North American and offshore mills in the first half eroded prices to the low $400s.

During 1982-86, overcapacity, combined with erratic U.S. economic growth and strong U.S. and Canadian currencies, hurt North American newsprint exports and drew imports from Scandinavia. The period began with an official list-price reduction from $500 to $468.50/metric ton in October 1982. The list was then raised to $535/metric ton in the third quarter of 1984, but this level was increasingly discounted until the end of 1986.

Such pricing caused the Canadian newsprint industry to decline sharply in the early 1980s. Jim Rowland of *Canadian Paper Analyst* estimated that pre-interest, pretax profit of Canadian producers on shipments to the U.S. declined from a high of about C$125/metric ton in 1980-81 to a low of $50 in 1983. It recovered to about $100 in 1986.

The success of the late-1986 price hike marked the dawning of a new cycle for the newsprint industry, one in which the producers would call the shots. Because of limited newsprint capacity expansions through the end of the decade, mills were expected to continue raising prices through 1988. However, price hikes failed in late 1988 and early 1989, and they were finally abandoned by mid-year. Instead, discounts grew. By summertime, a 19.2% discount was the going rate on contract orders of as little as 30,000 tons. Average orders were drawing discounts of 12% to 15%, and the largest buyers were able to negotiate prices 20% or more off of list price, which was $650/metric ton in the East and $630 (minus 5% "allowance") in the West.

Transaction prices improved somewhat in 1990 with the June price hike, raising market prices to about $565 in the East and $570 in the West by third quarter. If another list-price increase is implemented in January 1991, transaction prices would exceed those achieved back in 1987, before they began a gradual and continual slide. In real terms, though, it will take newsprint producers longer to catch up on actual operating margins.

As the 1980s drew to a close, the newsprint industry appeared to be embarking on an era when publishers could wield more influence on the marketplace. Not only were consolidations in the publishing business giving buyers more leverage in negotiating supply agreements, but many of the new mills coming online through 1991 were partially or wholly owned by publishing companies.

OUTLOOK

The outlook for newsprint through 1991 is bleak. Demand slowed in mid-1988 and flattened through 1989 and much of 1990. At the same time, about 2.5 million metric tons of new North American newsprint capacity began coming onstream, with 12 machines expected to start up during 1989-91.

Through the first three quarters of 1989, downtime was taken amounting to nearly 225,000 tons of newsprint production—almost entirely in Canada. This helped bolster the market somewhat, but it was not enough to prevent prices from continually sliding. A seasonal pickup in demand late in the third quarter allowed mills to return to more normal operating schedules, and the slide in prices stopped.

Market conditions remained stable through early 1990, confusing many market watchers. This unexpected turn of events was traced to low publisher inventories, the chance of strikes in eastern Canada by year end, and a combination of delayed new machine startups and a few unexpected permanent machine shutdowns. When labor problems racked up strikes at mills amounting to 23% of Canadian newsprint capacity at one point, the market really got tight and fueled another attempt to raise prices in January 1991.

Forecasters expected 1991 North American operating rates to dip down to the high 80s to low 90s, as the seven new newsprint machines that came onstream in 1989 and 1990 build up speed and are joined by another five machines coming onstream in 1991. U.S. mills may fare better than Canadians on operating rates, as more Canadian capacity could be idled as profits drop to below break-even levels for many of the older machines in Canada.

Total Canadian newsprint shipments in 1989 were up 1.4% to 9.6 million metric tons. While shipments to the U.S. dropped by 3.4% to 6.7 million tons and domestic shipments were off 4.8% to 1.1 million tons, offshore shipments increased by 25.8% to 1.7 million tons. In 1990, total Canadian shipments were projected to be down about 1.1%, with demand from the U.S. off significantly.

This level of Canadian shipments should result in a 1990 operating rate of about 95%—down from 96.2% in 1989, 99.0% in 1988, and 97.7% in 1987. Demand for Canadian newsprint will be further eroded by flat U.S. newsprint consumption, inventory drawdowns by publishers late in the year, and additional capacity expansion by U.S. newsprint producers.

Publishers lowered their inventories in 1989 because of plentiful newsprint supplies and declining newsprint prices. In 1990, stocks were built up gradually throughout the year as buyers sought to buffer themselves against any prolonged work stoppage in eastern Canada. However, with settlements in sight in the third quarter, newspapers were already thinking about working off stocks by year end.

In 1989, U.S. newsprint mills increased shipments by nearly 2% to 5.5 million metric tons, resulting in an operating rate of 96.9%. In 1990, U.S. newsprint shipments should be up 6.4%, but operating rates will remain a rela-

U.S. NEWSPRINT CONSUMPTION, DAILIES vs OTHER USES

(000 metric tons)

Year	ANPA "525"	Other dailies	Other uses	Total consumption
1989	7,546	1,593	3,102	12,241
1988	7,548	1,502r	3,195r	12,245r
1987	7,606	1,519	3,178	12,303r
1986	7,422	1,443	3,008	11,873r
1985	7,199	1,525	2,783	11,507r
1984	7,075	1,457	2,899	11,349r
1983	6,638	1,260	2,700	10,529r
1982	6,358	1,249	2,501	10,096r
1981	6,506	1,307	2,351	10,164
1980	6,581	1,208	2,299	10,088
1979	6,673	1,208	2,318	10,199
1978	6,446	1,174	2,257	9,877
1977	6,143	1,084	2,052	9,279
1976	5,928	1,020	1,771	8,719
% change 1976-89	27.3%	56.2%	75.2%	40.4%

r = Revised.
Source: American Newspaper Publishers Assn.

LARGEST U.S. DAILIES AND 1989 NEWSPRINT USAGE

Newspaper	Circulation[1]	Newsprint consumption[2] (metric tons)
Wall Street Journal	1,935,866	153,057
USA Today	1,387,233	150,000
Los Angeles Times	1,210,077	438,384
New York Daily News	1,180,139	154,143
New York Times	1,149,683	322,000
Washington Post	824,282	250,000
Chicago Tribune	740,713	215,925
Newsday	711,264	149,837
Detroit Free Press	639,767	89,617
San Francisco Chronicle	569,257	109,450

1. From Audit Bureau of Circulation figures as of Mar. 31, 1990.
2. Independent verification.
Source: "Newspaper and Newsprint Facts at a Glance," from Newsprint Information Committee.

tively weak 95% because of new newsprint capacity.

Operating rates of 95% and below usually signal the start of a buyer's market, where producers compete with each other on prices in order to protect their market shares. The situation is expected to get even more competitive in 1991, as operating rates dip lower.

A long-term forecast done for ANPA in 1986 by Jon G. Udell notes, "The future outlook for U.S. newspapers is favorable even though the U.S. economy may experience some difficult days in the years ahead. If difficulty does not occur, the 14.5-million-ton trend projection for 1995 will be exceeded. In fact, if newspaper and newsprint consumption were to repeat the growth rates of 1975-85, U.S. newsprint consumption would reach 16.3 million metric tons in 1995. However, one can strongly question whether newsprint supply would allow such a rapid expansion."

In a more recent update of that study conducted in December 1989, Udell's 1995 forecast remains unchanged, despite three consecutive years of flat consumption that he did not foresee. "The diversion is not yet of sufficient magnitude and duration to warrant a change in the 14.5-million-ton projection for 1995," noted Udell. A further review of this projection was planned for late 1990.

A year earlier, Udell stated that he was less positive about the trend of newsprint consumption tracking the U.S. economy. "The dynamics of the newsprint industries may reduce the future rise of U.S. newsprint consumption," he said. "The cost of newsprint, as well as other newspaper operating costs, will play a significant role in the future rise of newsprint consumption."

Edmund W.E. Hughes, vice president, east, of Canadian Pacific Forest Products Ltd., predicted that consumption patterns of newspaper publishers and other newsprint customers will change significantly in the years ahead. As a result, GNP will no longer be the guiding factor in newsprint consumption.

Consumption by users other than daily newspapers will grow from about 25% in 1988 to about 31% in the year 2000. These specialized publications (weeklies, shoppers, etc.) will be differentiated by a wide variety of quality specifications, the upper limits of which no newsprint mill in North America currently comes close to, said Hughes.

Overseas markets. World demand for newsprint in 1989 reached 31.5 million metric tons, according to CPPA. The Food & Agriculture Organization of the United Nations predicted that world consumption will grow to about 42 million tons in the year 2000. CPPA expected Canadian newsprint shipments to rise during this time to 12 million tons.

The largest share of total 1989 North American newsprint exports to offshore customers was from Canada. In fact, Canada shipped about three and a half times as much newsprint overseas as did the U.S. Offshore exports of U.S. newsprint, however, grew between 1980 and 1989, from 176,000 metric tons to 485,100 tons. For the same period, Canadian newsprint exports to offshore destinations were up slightly from 1.524 million metric tons to 1.714 million tons.

Exports to western Europe from Canada declined between 1980 and 1986 but began growing again in 1987. They increased in 1988 and again in 1989, reaching a new peak of 744,000 metric tons, with over 60% of that amount sold to the U.K. Exports to Asia dropped slightly in 1989 by 2.8% to 422,000 tons, while the Oceania region imported 161,000 tons of Canadian newsprint in 1989—up nearly 25% from the previous year. However, shipments from Canada to Latin America dropped by more than 10% to 350,000 tons. And the African market has dried up, with just 38,000 tons shipped to that continent from Canada in 1989.

Since 1980, Scandinavian producers have had an edge in trading with Western Europe. During that time, the European Economic Community imposed a tariff-free import quota of 650,000 metric tpy of newsprint not produced by EC countries; newsprint from Scandinavia entered Western Europe tariff-free.

Exports to the U.K. from Canada dropped significantly in the mid-1980s, due not only to falling newspaper circulation but also to currency exchange rates, increased imports from Scandinavia, and increased production within the

MEDIA SHARE OF U.S. ADVERTISING REVENUES

	1989		1988		1978		1970	
	million $	%	million $	%	million $	%	million $	%
Daily newspapers	$32,368	26.1%	$31,197	26.4%	$12,690	29.0%	$5,745	29.3%
Magazines	6,716	5.4	6,072	5.1	2,595	5.9	1,323	6.8
Television	26,891	21.7	25,686	21.8	8,850	20.2	3,665	3.7
Radio	8,323	6.8	7,798	6.6	2,995	6.8	1,278	6.5
Direct mail	21,945	17.7	21,115	17.9	6,030	13.8	2,734	13.9
Business publications	2,763	2.2	2,610	2.2	1,420	3.2	740	3.8
Outdoor	1,111	0.9	1,064	0.9	465	1.1	234	1.2
Others	23,601	19.2	22,312	19.1	8,735	20.0	3,881	19.8
Total	123,930		118,050		43,740		19,600	

Sources: McCann-Erickson Inc., Newspaper Advertising Bureau Inc.

U.K. This trend continued through the 1980s.

With Japanese newsprint consumption projected to rise over the next few years, North American producers have an expanded market to cultivate. They should have an advantage over other global suppliers because of Japanese ownership in several U.S. and Canadian newsprint mills.

Japan is already a leading customer for the U.S., with Jujo Paper Co. Ltd.'s 20% interest in the North Pacific Paper Corp. mill at Longview, Wash., and Daishowa America Inc.'s ownership of the Port Angeles, Wash., mill. In Canada, Oji Paper Co.'s 50% partnership with Canfor Corp. in the new Howe Sound venture will have a significant effect on where that mill's output is marketed.

Two new paper machines are being built in Japan. A 108,000-tpy unit was started up in February 1990 at Taio Paper's Mishima, Japan, mill, and another 220,000-tpy unit is slated for May 1991 startup at Daishowa's Iwanuma, Japan, mill. Other machines starting up in Asia include Hindustan Newsprint's 45,000-tpy machine at the Kumarbagh, India, mill in 1991.

Rep. Korea, too, is expanding. It is likely to become a bigger exporter of newsprint in 1990-92, when two new machines amounting to about 200,000 tpy of new capacity are scheduled to come online. Based on a 15% annual growth rate projected by Goldman Sachs over the 1989-91 period and an 85% operating rate, Rep. Korea's newsprint exports will jump 47.5% from 1988 to 1991—from 20,000 tons to 115,000 tons.

In early 1992, Venezuela was expected to bring online a new 200,000-tpy newsprint mill—that country's first. However, the partners, Abitibi-Price Inc. and Bowater Inc., had not yet decided definitely to go ahead with this project as of late 1990. The mill would displace not only 150,000 tpy of imported newsprint now required for Venezuelan domestic

NORTH AMERICAN DEINKED NEWSPRINT PROJECTS, 1990-94

Company/mill site	Startup	Deinking capacity[1] (metric tpy)	Recycled fiber content (%)	Recycled requirements (metric tpy)	grades
Definite					
Alabama River Newsprint, Claiborne, Ala.	Late 1991	110,000[3]	40%	127,000	ONP, OMG
Atlantic Packaging, Whitby, Ont.	Jan. 1990	135,000[2]	100	160,000	ONP, OMG
Augusta Newsprint, Augusta, Ga.	Sept. 1990	90,000[3]	Var.	100,000+	ONP, OMG
Boise Cascade, West Tacoma, Wash.	1992	72,000[3]	40	108,000	ONP, OMG
Bowater, Calhoun, Tenn.	Dec. 1991	109,500[3]	Var.	130,000	ONP, OMG
Canadian Pacific					
Thunder Bay, Ont.	Mid-1991	100,000[3]	Var.	120,000	ONP, OMG
Gatineau, Que.	Mid-1991	182,500[3]	Var.	215,000	ONP, OMG
Champion International, Sheldon, Texas	Late 1992	130,000[3]	20	160,000	ONP, OMG
Daishowa Forest, Quebec City, Que.	1Q 1992	110,000[3]	n.a.	120,000	ONP, OMG
Inland Empire, Millwood, Wash.	Late 1991	40,000[3]	40	45,000	ONP
Kruger, Bromptonville, Que.	Late 1991	50,000[3]	Var.	65,000	n.a.
Newstech Recycling, Vancouver, B.C.	4Q 1991	122,500[4]	—	140,000	ONP
North Pacific Paper, Longview, Wash.	Apr. 1991	230,000[2]	Var.	250,000	ONP
Smurfit Newsprint, New York State	1994+	255,000[2]	100	300,000	ONP, OMG
Stone-Consolidated, Shawinigan, Que.	End 1991	n.a.[3]	n.a.	n.a.	n.a.
Indefinite					
Abitibi-Price, site undecided	n.a.	n.a.[3]	n.a.	n.a.	n.a.
Atlantic Packaging, Whitby, Ont.	n.a.	n.a.[2]	100	n.a.	n.a.
Bear Island, Ashland, Va.	n.a.	n.a.[3]	n.a.	n.a.	n.a.
Boise Cascade, Kenora, Ont.	n.a.	n.a.[3]	40	n.a.	n.a.
Donahue, Clermont, Que., or Montreal, Que.	n.a.	85,000[3]	n.a.	n.a.	n.a.
Georgia-Pacific, East Millinocket, Maine	Late 1992	80,000[3]	40	90,000	ONP, OMG
Smurfit Newsprint, Pomona, Calif.	n.a.	210,000[2]	100	n.a.	n.a.
Kruger, Bromptonville, Que.	n.a.	100,000[3]	n.a.	n.a.	n.a.
Orford Recycling, Drummondville, Que.	n.a.	120,000[4]	?	n.a.	n.a.
Smurfit Newsprint, Newberg, Ore.	n.a.	275,000[2]	50+	n.a.	n.a.
Westbrook Wood Products, Klamath Falls, Ore.	n.a.	200,000[2]	50	120,000	n.a.

1. Adding deinking capacity does not necessarily mean an increase in papermaking capacity.
2. New paper machines at greenfield or existing mills.
3. New deinking facilities to be added to existing mills.
4. Greenfield market deinked pulp mills.

ONP = Old newspapers. OMG = Old magazines. Var. = Variable.

Sources: Canadian Pulp & Paper Assn., *Pulp & Paper Week*.

consumption but also 50,000 tpy used by the surrounding countries of Colombia, Guyana, Surinam, and Brazil, according to Goldman Sachs.

In Western Europe, though, three expansions are planned during 1990-93. These include for 1990 startup a 135,000-metric-tpy expansion at Haindl's Schongau, West Germany, mill; a 100,000-tpy expansion at Stryremuehl Papierfabriks AG's Steyrermuehl, Austria, mill; and a 225,000-tpy new paper machine at United Paper Mill's Stracel mill in Strasbourg, France. In 1992, Norske is bringing onstream a new 200,000-tpy mill in Gobley, France. In 1993, Papel de Edicones (Padesa) will have completed a 200,000-tpy mill in Alava or Burgos, Spain.

Plans to build a 220,000-tpy recycled newsprint mill in Gartcosh, Scotland, were still uncertain late in 1990. Abitibi was to be equal partners in the project with two publishers, The Daily Telegram plc and Mirror Group Newspapers Ltd. The new company, called North British Newsprint Ltd., was projecting ground-breaking for early 1991 and mill completion by 1993.

COMPARATIVE NEWSPRINT MANUFACTURING COSTS FOR MAJOR PRODUCING REGIONS, 1988

(US$/metric ton)

	Canada	U.S. West	U.S. South	Finland	Sweden
Furnish material	139	152	113	221	176
Energy	63	69	73	82	82
Labor	96	59	70	49	61
Other	64	72	87	54	69
Mill level cost	362	352	343	406	388
Corporate/ selling cost	24	12	17	28	13
Cost before delivery	387	364	360	434	401
Delivery	69	43	30	73	74
Total delivered cost	455	407	390	507	474

Source: Forest Sector Advisory Council of Canada, "Newsprint Cost Study" for 1982, 1983-87, and 1984-88.

HISTORICAL TREND IN TOTAL NEWSPRINT DELIVERED COST, 1982-90

(US$/metric ton)

	1990*	1989	1987	1986	1985	1984	1983	1982
Canada	$512	$455	$405	$381	$379	$385	$407	$408
U.S. West	440	407	372	368	378	388	370	387
U.S. South	422	390	384	351	379	384	379	368
Finland	626	507	552	440	409	331	369	384
Sweden	570	474	490	418	382	306	312	322

* *Pulp & Paper Week* estimate based on exchange rate in August 1990 and including effect of inflation.
Source: Forest Sector Advisory Council of Canada, "Newsprint Cost Study" for 1982-86, 1983-87, and 1984-88.

Paper:

UNCOATED GROUNDWOOD

Uncoated groundwood papers have similar physical properties to newsprint and use primarily stone groundwood pulp. But uncoated groundwood has better printing characteristics, falling between newsprint and coated paper as an intermediate printing medium, and is priced above standard newsprint. The exception is the small 170,000-short-tpy groundwood forms paper sector, which competes with uncoated free-sheet forms bond.

Uncoated groundwood grades are brighter than newsprint, starting at about 64 Elrepho and going as high as 72, whereas newsprint brightness falls between 56 and 62 Elrepho. Brightness levels for uncoated groundwoods are below coated groundwoods, which are in the low- to mid-70s. Uncoated groundwoods are also considered to be below coated groundwoods in overall printing qualities.

Large newsprint mills became the first major producers of groundwood papers, often by converting older newsprint machines, a trend still common in Canada. New, larger machines also have been installed in recent years, and some greenfield mills have been built, such as Lake Superior Paper Industries at Duluth, Minn. Overcapacity in newsprint and customer de-mands for papers with better appearance characteristics have fueled the conversions. Newsprint machines are upgraded to uncoated groundwood by adding fillers, using more chemical furnish, and adding on-machine calendering or off-machine supercalendering. Basis weights range from 18 to 40 lb (24 x 36 in., 500 sheets) or 30 to 66 g/m^2.

Scandinavian mills pioneered supercalendered (SC) papers. SC papers are classified in three grades: unfilled SC-C (essentially a higher-quality newsprint), low-filled SC-B,

STATISTICS FOR UNCOATED GROUNDWOOD PAPER*

	1990e	1989	1988r	1987r	1986	1985
United States						
Production, 000 tons	1,765	1,754	1,624	1,498	1,540	1,521
Capacity[1], 000 tons	1,808	1,846	1,735	1,653	1,685	1,644
Utilization rate, %	97.6%	95.0%	93.6%	90.6%	91.4%	92.5%
Imports, 000 tons	1,552	1,470	1,404	1,270	1,028	1,027
Exports, 000 tons	90	71	66	56	41	37
Apparent U.S. consumption						
000 tons	3,227	3,153	2,962	2,712	2,527	2,511
lb/capita	25.77	25.30	24.01	22.31	20.98	21.05
000 tons/billion $ real GNP (1982)	0.76	0.76	0.74	0.70	0.68	0.69
Canada[2]						
Production, 000 tons	1,971	1,776	1,628	1,477	1,343	1,146
Capacity, 000 tons	2,006	1,808	1,664	1,499	1,391	1,146
Exports, 000 tons	1,695	1,527	1,382	1,256	1,138	992
Utilization rate, %	98.3%	98.2%	97.8%	98.5%	96.5%	100.0%

*All tons are short tons.
e = Estimate.
r = Revised.
1. American Paper Institute.
2. Canadian Pulp & Paper Assn.

and high-filled SC-A, the grade that competes most directly with coated No. 5 paper in magazines and catalogs. Finnish paper mills Kymmene Corp., United Paper Mills Ltd., and Tampella Ltd. offer an intermediate grade between SC-A and coated No. 5. In addition, Malette Inc. plans to turn the former St-Raymond Paper Inc. newsprint and groundwood mill in St-Raymond, Que., to this type of paper. Other mills in Fed. Rep. Germany, Austria, and Finland also planned to ship the new coated groundwood grade.

Mills are also improving the quality of their premium SC papers. Such a case is Abitibi-Price Inc., which offers its web-size offset paper (WSOP), licensed to Abitibi by Metsäliiton Teollisuus Oy of Finland. Abitibi rebuilt a paper machine at the Kenogami mill in Jonquière, Que., which produces about 70,000 tons of this paper when operating at full capacity. Lake Superior, a project of Pentair Inc. and Minnesota Power, uses technology from the German Haindl Papier GmbH to make up to 240,000 short tpy of premium SC paper. The Duluth, Minn., mill began operations in November 1987, and a second machine is being considered.

U.S. PRODUCTION AND CAPACITY FOR UNCOATED GROUNDWOOD PAPER

(000 short tons)

	Production		
Year	Census	API[1]	Capacity[2]
1992	—	—	1,905
1991	—	—	1,877
1990	—	1,765e	1,808
1989	1,764	1,754	1,846
1988	1,647	1,624	1,735
1987	1,485	1,498	1,653
1986	1,539	1,540	1,685
1985	1,521	1,521	1,710
1984	1,565	1,565	1,622
1983	1,604	1,531	1,642
1982	1,499	1,471	1,655
1981	1,428	1,471	1,625
1980	1,538	1,499	1,624
1979	1,800	1,509	1,537
1978	1,636	1,354	1,453
1977	1,589	1,360	1,367
1976	1,560	1,321	1,309
1975	1,294	1,127	1,329
1974	1,411	1,192	1,280
1973	1,416	1,181	1,403
1972	1,308	1,126	1,442
1971	1,186	1,089	1,363
1970	1,214	1,085	1,230
1969	1,208	1,095	1,296

e = *Pulp & Paper* estimate.
1. Shipments.
2. American Paper Institute "Capacity Survey," 1989.
Sources: American Paper Institute, Bureau of the Census, *Pulp & Paper Forecaster.*

Approximate 1989 North American demand estimates for various end uses for uncoated groundwood grades are as follows: catalog, 500,000 tpy; directory, 660,000 tpy; newspaper inserts and direct-mail advertising circulars, 1.3 million tpy; periodicals (magazine and Sunday supplements), 620,000 tpy; business papers, including forms and carbonless basestock, 400,000 tpy; and miscellaneous (books, basestock for converting, and exports), over 1.2 million tpy.

Retailers such as Sears, Roebuck & Co., Spiegel, and J.C. Penney, plus 6,500 specialty stores, mail-order houses, and other merchandisers, are the primary consumers of catalog-grade papers. One study estimated that 2.8 million tons of paper were used in catalogs in 1989. About 12% was SC; 5% other uncoated groundwood, such as machine-

UNCOATED GROUNDWOOD PAPERS TYPICAL GRADE STRUCTURE

Grade	Basis weight[1]
Rotogravure[2] (standard, premium, high brightness)	33, 35 lb (25 x 38 in., 500 sheets)
Offset[2] (premium, high brightness)	28, 35, 38, 45 lb (25 x 38 in., 500 sheets)
Magazine (gravure, offset)	35 lb (25 x 38 in., 500 sheets)
Paperback/book	35, 37 lb (25 x 38 in., 500 sheets)
Directory (white, yellow)	20, 22.5 lb (24 x 36 in., 500 sheets)
Computer	15, 18 lb (17 x 22 in., 500 sheets)

1. Typical weights offered by producers. Other weights may be available.
2. Catalog grades.

GPO MINIMUM ACCEPTABLE PROPERTIES FOR GROUNDWOOD PAPER FORMS

Basis weight				
lb*	12	15	18	20
g/m²	45	56	68	75
Burst	7	8	11	14
Opacity, %	80	80	80	80
Caliper				
0.001 in.	2.8	3.5	4.2	4.6
mm	0.071	0.089	0.109	0.117

* Ream size: 17 x 22 in., 500 sheets.

finish (MF); 38% coated No. 5; and 40% coated Nos. 3 and 4. The remaining 10% was a combination of other coated grades and a small amount of uncoated free-sheet.

Catalogs are printed either on rotogravure or offset presses, with gravure printing favored for longer runs because of economic advantages. Some catalog publishers will shift from uncoated groundwood to lightweight coated (LWC) paper, or from LWC to coated free-sheet, in order to enhance appearance. Others will move down from coated groundwood to SC or even MF paper to save costs. Traditional catalog paper, which is similar to lightweight newsprint or telephone directory paper, has been hurt by competition from SC. Some mass marketers still use lower-quality grades, such as high-brightness newsprint and standard newsprint, when quality of image is not important (e.g., J.C. Whitney & Co. Inc.'s auto parts catalog).

Directory paper has a lower gloss and brightness than catalog paper, and for telephone books, it is generally made with a 22- to 23-lb basis weight, although some publishers use 20-lb and 18-lb paper. The breakup of American Telephone & Telegraph Co. and court decisions to allow widespread use of the Yellow Pages name and logo at first spurred growth in independent and specialized directories, such as Business-to-Business, Silver Pages (for senior citizens) and ethnic or market-related books. However, the last few years have brought a shakeout to the directory publishing industry, with small books and a few big ones like the Silver Pages being discontinued or purchased by larger companies.

"Many publishers for the Regional Bell Operating Companies (RBOCs) have withdrawn from competitive or specialty markets . . . and renewed their focus on the core yellow page product within their own 'Bell-sanctioned' markets," said Douglas Parker, manager of paper administration for US West Direct. Speaking at *Pulp & Paper*'s Fourth Groundwood Papers Conference in October 1989, Parker said that independents, including those owned by RBOCs, have withdrawn from markets that were unprofitable or stagnant. The defections followed a downturn in general advertising.

Some 660,000 tons of directory paper have been purchased annually by North American directory printers and publishers between 1986 and 1989—up from 588,000 tons in 1985.

Publishers have cut costs by reducing the size of their books. One method is to make better use of page layout designs to eliminate filler ads, according to Larry Small, marketing manager for the Yellow Pages Publishers Assn. He also said that fewer white pages directories will be published as the costs of production rise. In 1987, about 6,500 volumes were published, and the number has dropped to 6,200 since then. "Within the last two years, there's been a pretty good shakeout," Small said.

Some publishers are shifting to coated glossy stock for printing special sections. Advances in printing technology and demands for better printing quality also could change the outlook for directory paper stock. Four-color printing and growing use of cover advertisements and inside coupons all increase the need for stronger and brighter papers.

About 34% of the uncoated groundwood segment is SC paper. Its share should increase to nearly 40% by 1998. Around 2.3 million tons of SC are consumed by the U.S., making SC almost a commodity grade. Major producers and their capacities are Lake Superior Paper Industries, 240,000 tpy; Madison Paper Corp., 165,000 tpy; Champion Interna-

ESTIMATED CAPACITIES OF MAJOR COMPANIES FOR UNCOATED GROUNDWOOD PAPER

(000 short tons)

	Company	1990 annual capacity U.S.	Canada	Total	Market share %
1.	Abitibi-Price	—	525	525	14.4%
2.	MacMillan Bloedel[1]	—	444	444	10.2
3.	Canadian Pacific Forest Products	—	430	430	9.9
4.	Stone-Consolidated	—	423	423	9.7
5.	Georgia-Pacific Corp.[2]	212	—	212	6.6
6.	Boise Cascade	—	270	270	6.2
7.	Lake Superior Paper	240	—	240	5.5
8.	Champion International[3]	229	—	229	5.5
9.	Domtar	—	190	190	4.4
10.	St. Marys Paper	—	185	185	4.3
11.	Madison Paper	175	—	175	4.0
12.	Kimberly-Clark	131	41	172	4.0
13.	James River	148	—	148	3.4
14.	Fraser[1]	135	—	135	3.1
15.	Daishowa America	130	—	130	3.0
16.	Kruger	—	55	55	1.3

North American capacity (1990): 3,646 million tons
U.S., 1.762; Canada, 2.200[4]
Capacity share of top five companies: 55.8%
Capacity share of top ten companies: 86.3%

[1] MacMillan Bloedel & Fraser owned by Noranda Forest Inc.

[2] (Great) Northern Paper Div., Millinocket, Maine.

[3] 1989 production.

[4] Company figures are higher than official industry estimates.

tional Corp., 120,000 tpy; St. Marys Paper, 125,000 metric tpy; Abitibi-Price, 140,000 metric tpy; and Kruger Inc., 50,000 metric tpy.

So far, North American magazines are much less likely to use SC paper than are their European counterparts, which have been doing so for many years. SC is popular in North America for advertising inserts, flyers, other periodicals, and newspaper supplements.

European publishers have shown much broader acceptance of SC papers for consumer and trade magazines. In 1987, about 277,000 tons of SC paper were used for Sunday magazines and supplements, much of it by the *New York Times*. Inserts and flyers consumed about 541,000 tons, and catalogs used 325,000 tons. The remainder, about 62,000 tons, went to book publishers and commercial printers for jobs other than inserts/flyers.

SC papers have a clay content ranging from almost nothing to 25% or more. Clay (kaolin) and other pigments enhance appearance by adding brightness, opacity, strength, and bulk. Use of kaolin pigments in groundwood papers has grown because of advertiser demands for better paper quality, according to C.D. Richardson, director of sales in the U.S. and Canada for Engelhard Corp. Richardson told delegates at the *Pulp & Paper* Groundwood Papers Conference that SC papers have basis weights ranging from 41 to 82 g/m^2, and they contain at least 50% mechanical pulp, with the balance made up of chemical fiber. Filler content is usually between 15% and 30%.

UNCOATED GROUNDWOOD PAPERS: CANADIAN PRODUCTION, EXPORTS, AND CAPACITY

(000 short tons)

Year	Production[1]	Exports[2]	Capacity[1]
1990e	1,971	1,695	2,006
1989	1,776	1,527	1,808
1988	1,682	1,382	1,664
1987	1,477	1,256	1,499
1986	1,343	1,138	1,391
1985	1,146	992	1,146
1984	1,000	845	1,020
1983	843	575	882
1982	715	460	827
1981	711	320	728
1980	677	305	728
1979	625	321	702
1978	580	266	675
1977	463	193	560
1976	363	133	480
1975	315	140	402
1974	401	183	440
1973	319e	184	412

e = *Pulp & Paper* estimate.
r = Revised.
1. Canadian Pulp & Paper Assn.
2. *Statistics Canada*.

The calendering process, which is evolving from "hard" to "soft" calendering, also affects the quality of SC paper. All of these papers are called "smooth papers" by John G. Davis, executive vice president of printing papers at Abitibi-Price. He told conference delegates that smooth papers will grow 8% to 10% annually during the next five to ten years—far more than any other groundwood grade and even higher than the 5% to 6% expected for LWC papers.

The groundwood forms market is doing less well. Davis projected "fair" growth of 3% to 5%/year—substantially below the growth rate of five or ten years ago. Even though the forms market as a whole will grow, the groundwood segment will probably decline as a percentage of the total. In 1988, shipments of groundwood papers fell 25% from 1987 levels, and they accounted for 6% of total forms shipments, compared with 8% in 1987. In 1989, forms paper shipped to forms converters fell another 2%.

Groundwood forms are used for less important computer printouts, such as internal sales documentation and reports, and they are priced as much as $200/ton less than free-sheet forms bond. A free-sheet/groundwood blend used by some major U.S. formsmakers is priced between the two grades.

The trend toward cut-sheet printers is also reducing the groundwood forms segment because nearly all of the cut-size market is free-sheet. However, the addition of new fibers such as chemi-thermomechanical pulp (CTMP) provides a better sheet than standard groundwood forms, but at a lower cost than free-sheet. CTMP-based papers are more prone to brightness reversion (discoloring of paper as it ages) than free-sheet, but less so than groundwood.

Groundwood-based forms bond is divided into three categories. The first is low-content groundwood papers,

LIGHTWEIGHT (CATALOG/DIRECTORY) PAPER CAPACITIES IN NORTH AMERICA*

(000 short tons)

Company	Capacity	Mill producing
MacMillan Bloedel	220	Port Alberni, Powell River, B.C.
Georgia Pacific[1]	169	Millinocket, Maine
Daishowa	170	Port Angeles, Wash.; Quebec City, Que.
Fraser[2]	130	Madawaska, Maine
Abitibi-Price	107	Alma, Jonquière, Que.
Champion International[3]	90	Lufkin, Texas; Deferiet, N.Y.
Stone-Consolidated[4]	72	Trois Rivières, Que.
James River[5]	35	Clatskanie, Ore.

*1989 estimated.
1. Also has newsprint machines qualified for directory at East Millinocket, Maine.
2. Owned by Noranda Forest Inc.
3. St. Regis Div.
4. Also has swing capacity on other machines.
5. *Pulp & Paper* estimate; total machine capacity is 140,000 tpy.
Sources: Company data, *Pulp & Paper* estimates.

which contain from 10% to 50% groundwood fiber and have brightness levels ranging from 72 to 77. In computer applications, these papers are similar to uncoated free-sheet and forms bond in appearance and performance. They often are used in lieu of register bond in stock continuous forms, and colored papers in this grade sometimes are substituted for colored free-sheet papers. The second—and largest—category consists of papers with over 50% groundwood content and low brightness of about 65. The third category contains papers used as basestock for carbonless forms. Called low-ply chemical carbonless papers, they range in brightness from 70 to 74, and they are used primarily for multiple-part stock continuous forms.

Compared with free-sheet forms bond, groundwood forms bond has a lower brightness level and a tendency to age rapidly. Uncoated free-sheet is still preferred for archival purposes or for external presentation. Thus, custom continuous forms often use free-sheet, while groundwood is acceptable for internally used and quickly discarded stock continuous forms.

The cyclical nature of the market in terms of supply and demand encouraged some converters in 1973-74 to consider groundwood as an alternative. However, groundwood paper at that time had significant problems, including poor refoldability, which can slow down operations of a high-speed printer; lint on the sheet surface, which wears out printer ribbons faster than normal; inadequate internal strength, causing line holes to rip apart on some fast printers and leading to paper jams; inability to punch cleanly, leaving punch holes (chad) to jam the printer; and abrasiveness, causing converters' line hole punches and perf blades to wear out more quickly than with free-sheet forms paper. Groundwood pulps have improved substantially since then due to advances in cleaning and refining.

PRODUCTION/CAPACITY

Canadian mills produced most of North America's uncoated groundwood paper tonnage during the past two decades, as they did with newsprint. That is because many newsprint mills were converted to production of groundwood specialties. At first, these mills made rotogravure newsprint, MF offset, and lightweight news (telephone directory paper). U.S. production of uncoated groundwood papers generally climbed during the 1970s and 1980s, except for slight drops in 1980-83 and in 1987. Canadian uncoated groundwood paper production increased more steadily during the past decade. Of course, much of the

UNCOATED GROUNDWOOD EXPANSIONS

Company	Location	Annual short tons	Startup	Nature of work
Abitibi-Price	Alma, Que.	65,000	1988	Convert to LW catalog and directory
St. Marys Paper	Sault Ste. Marie, Ont.	172,000	1988	Build new SC machine
F.F. Soucy	Rivière-du-Loup, Que.	22,000	1989	Rebuild news/groundwood machine
Kruger	Trois Rivières, Que.	30,000	1989	
Stone-Consolidated	Trois Rivières, Que.	33,000	1989	
Stone-Consolidated	Grand'Mère, Que.	125,000(net)	1990	Build new specialties machine
Kruger	Corner Brook, Nfld.	77,000	1990	Convert No. 4 newsprint machine to unfilled and low-filled SC
Boise Canada	Fort Frances, Ont.	49,600	1990	Ugrade mill to raise groundwood specialties capacity
Fletcher Challenge	Campbell River, B.C.	22,000	1990	Upgrade No. 2 newsprint machine to soft calendered SC-B equivalent
Daishowa America	Port Angeles, Wash.	150,000	Postponed	Build new directory machine
Lake Superior Paper	Duluth, Minn.	245,000	Proposed	Second SC machine
Cascades	Port Cartier, Que.	210,000	Proposed	
Madison Paper	Madison, Maine	170,000	Canceled	New SC machine
Madison Paper	Madison, Maine	n.a.	Under study	Rebuild two supercalenders; may add recycled fiber capacity
Smurfit	Oregon City, Ore.	n.a.	Under study	May convert one or more newsprint machines to machine-finished and SC papers
Westbrook	Klamath Falls, Ore.	n.a.	Proposed	Seeking partners for publication papers mill
Daishowa Canada	Quebec City, Que.	n.a.	Under study	Build new 300-tpd deinking plant for recycled newsprint/directory paper

North American capacities, 1990
U.S.: 1.808 million short tons
Canada: 1.839 million metric tons (may be understated)

n.a. = Not available.
Sources: *Pulp & Paper Week, Pulp & Paper Project Report.*

Canadian tonnage was shipped to the U.S., as was newsprint.

The American Paper Institute reported U.S. mill production (measured by shipments) as slightly less than 1.2 million tons in 1973. It jumped to 1.5 million tons in 1983 and was expected to reach almost 1.7 million tons in 1989. Similarly, Canadian mills produced about 319,000 tons in 1973, compared with 843,000 tons in 1983 and an estimated 1.8 million tons in 1989. However, the early figures for Canada are probably too low, as a large amount of groundwood paper (rotonews) was actually classified as newsprint in order to gain the duty-free status of newsprint.

Uncoated groundwood capacity at U.S. mills was about 1.4 million tons in 1973, 1.6 million tons in 1983, and an estimated 1.7 million tons in 1989. Canadian mills had capacity for 412,000 tons in 1973, 882,000 tons in 1983, and almost 1.9 million tons in 1989. As with production, Canadian capacity is probably 25% higher than industry figures.

Little major new capacity is scheduled to come online in the next few years, with the exception of Stone-Consolidated Inc.'s new machine at Grand-Mère, Que. Lake Superior has postponed at least until 1990 its decision to add a second 240,000-tpy SC machine at Duluth, Minn., because of weaker market conditions and other factors. Most of the additional tonnage will come from improvements of existing groundwood machines and conversions of small machines. Kruger is converting a small newsprint machine to SC at Trois Rivières, Que.

OUTLOOK

Groundwood capacity additions of new SC, LWC, and European intermediate grades (so-called No. 6) have led some forecasters to temper their optimistic predictions of a booming industry. The crunch in newsprint in 1989 and early 1990 was affecting prices for groundwood grades, causing general discounting across the board, except for premium SC grades, which more closely follow coated No. 5. Because of the relative weakness in demand, mills are scrutinizing their operations for ways to improve efficiency. At least one industry executive thinks it is time mills retired some of the older groundwood machines that can no longer be rebuilt with satisfactory financial returns.

"What do we do with this mill, now 50 or 60 years old?" asked John G. Davis, executive vice president, printing papers group, at Abitibi-Price. He told delegates at the *Pulp & Paper* Groundwood Papers Conference that some mills will probably be shut down. Factors affecting the viability of mills include the growing trends toward recycling and stronger environmental controls. "Mills that die over the next few years will likely do so because the grants and concessions won't be enough to fix them up and bring them into environmental compliance," Davis said.

Davis expects little or no capacity for directory or forms paper will come from expensive machine conversions. In addition, low-grade MF paper capacity will decrease by as much as 50% during the 1990s in North America. Conversely, said Davis, SC capacity will grow rapidly with two or three new publication-quality machines, but he fears a proliferation of soft-calendered smooth papers coming from newsprint conversions. Add to this the fact that European SC capacity will remain glutted for several years, and the outlook is not so strong from a sales standpoint.

Davis described several mitigating factors against the conversion of old machines:

- Soft-nip calenders are expensive, and the addition of clay leads to heavy environmental expenditures, as well as technical difficulties from closing up whitewater systems.
- The grades made on converted machines will not be isolated into specialty niche markets. More likely, they will compete with those made on low-cost, efficient, commodity-type machines.
- Ongoing return on the considerable capital investments will be marginal.
- Overcapacity will persist in Europe and is projected for North America as well.

NEW AND PROPOSED NORTH AMERICAN SUPERCALENDERED CAPACITY

Company	Mill	Capacity (000 short tons)	Date
Canadian Pacific Forest Products	Trois Rivières, Que.	70	1987
Abitibi-Price	Jonquière, Que.	65	1987
Lake Superior Paper[1]	Duluth, Minn.	240	1987
St. Marys Paper	Sault Ste. Marie, Ont.	131	1988
Madison Paper	Madison, Maine	182	1988-89
Stone-Consolidated[2]	Grand'Mère, Que.	202	1990
Kruger	Trois Rivières, Que.	70	1991
Lake Superior Paper	Duluth, Minn.	240	Delayed
Madison Paper	Madison, Maine	n.a.	n.a.
Wilbert Associates	Globe, Ariz.	200	Proposed

n.a. = Not available.

1. Partly owned by Pentair Inc.

2. Grade driven by market—may be rotonews or SC.

According to the July 1990 European Paper Institute's "Paper Capacity Report on Woodcontaining Publication Papers in Reels," SC paper shipments will advance only about 1.6% for each of the years from 1990 to 1994. Total 1994 capacity will be about 3.3 million tons, not including proposed projects. EPI figures suggest that Finland will retain its market position with 43% of total European SC capacity, while Fed. Rep. Germany will decline from about 33% to 30% over the period.

Some of the coated paper expansion includes the relatively new lightly pigmented grades, often referred to as No. 6 in North America. So far, there is no lightly pigmented capacity in North America, but Malette Inc. plans to convert the former St-Raymond newsprint and groundwood specialties mill in St-Raymond, Que., to that grade by 1992. Malette will produce about 70,000 metric tpy of the grade.

Gains in capacity will outpace deliveries, rising an average of 5.9%/year, compared with just under 5%/year for shipments. Both Fed. Rep. Germany and Finland will lose some market share among European coated producers but will remain the major players with 28% and 32% of total capacity in 1994, respectively.

EPI explained that almost half of the increase in capacity comes from projects already under construction. This includes new machines, rebuilds, and conversions. If proposed projects of about 2 million tons come to fruition, operating rates could drop even lower.

Mill operating rates for the relatively small amount of other uncoated mechanical tonnage will remain above 92% for the 1990-94 period, though capacity will rise 30.8% for the period, or about 7%/year, EPI figures indicate. Deliveries will rise approximately 5%/year. Finland will increase its market share from 52% of capacity in 1990 to almost 60% in 1994.

That means that North American producers with older machines will have to look carefully at their mills. "The $64,000 question," said Davis, "is how much these factors will withstand the industry's powerful, driving force to solve facility problems. At this point, the mill should be allowed to die, and a new one built in its place. But old mills don't die easily, and we don't know how to kill them. The sociological consequences are too difficult for the owners, unions, or government to handle."

Market demands will draw groundwood papers further away from newsprint and more toward the qualities of fine papers. This will occur as pressure increases for recycling; currently, only one mill makes SC paper from recycled fiber. At some point, groundwood mills will have to develop the technology to use deinked old newspapers in LWC and SC papers, Davis said.

As for market segment demand, Davis expects slow growth in directory papers—about 2% to 4%/year. Forms papers should have "fair" growth of 3% to 5% annually. The MF groundwood grades will continue declining by about 2% to 5%/year. Fast growth of 8% to 10% annually is projected for "smooth papers," including SC. LWC papers also will experience good growth of about 5% to 6%/year, Davis said.

Market trends affecting the use of groundwood papers are reflected by advertising expenditures. Print's share of advertising spending has increased slightly compared with broadcast, according to Claude Giroux, vice president and marketing director for Academy-Ogilvy Communications Inc., an affiliate of Ogilvy & Mather.

Giroux told delegates at the Groundwood Papers Conference that "the paperless society did not make it past the 'blue sky' stage: 58.5% of all U.S. advertising expenditures in 1989 were in a print medium, up slightly vs 56.5% in 1980." In contrast, broadcast has held steady at about 28% or 29% share. Giroux said that print remains the most powerful way of delivering a personalized message to an increasingly segmented market of well-educated people. In terms of dollars spent, print has gained 144% since 1980 for a total of $73.9 billion in 1989.

Daily newspapers account for the biggest chunk of 1989 spending at $32.7 billion—up 121% from the beginning of

CANADIAN UNCOATED GROUNDWOOD PAPER EXPORTS

(short tons)

Destination	1988*	1987	1986	1985	1984	1983	1982	1981	1980
U.K.	77,100	23,590	n.a.	n.a.	n.a.	505	n.a.	7,325	9,432
Benelux	2,507	n.a.	n.a.	n.a.	30	n.a.	n.a.	n.a.	1,549
Hong Kong	8,619	1,867	3,695	3,188	2,876	1,226	2,867	4,285	7,484
Singapore	5,153	0	n.a.	n.a.	n.a.	n.a.	2,078	3,972	2,773
Japan	57,764	132	56	10,556	10,647	9,248	n.a.	23	n.a.
Philippines	n.a.	0	n.a.	n.a.	13	n.a.	1,739	1,842	1,312
Thailand	4,422	0	n.a.	1,688	2,574	483	786	n.a.	1,595
Other Asia[1]	39,106	n.a.	n.a.	43	142	110	1,068	109	572
Australia	9,976	2,127	1,216	2,798	4,161	2,331	8,189	3,387	18,434
Colombia	6,188	0	1,351	2,244	1,922	2,752	1,571	4,087	2,101
Venezuela	30,835	11,381	n.a.	n.a.	n.a.	1,217	n.a.	981	n.a.
Other Latin America[1]	10,960	n.a.	1,348	1,150	720	1,387	1,652	794	1,070
U.S.	1,203,242	737,685	658,129	544,212	695,312	556,048	439,338	292,460	258,768
Total	1,504,181	780,400	665,862	566,473	718,637	575,307	459,288	318,265	305,090

*Changed to harmonized system in 1988.
n.a. = Not available.
1. Not necessarily same countries each year.
Source: *Statistics Canada* (commodity class 351-49 to 1987; HS 4802.60 in 1988).

the decade. Daily newspapers' share of total print expenditures has decreased from 48.9% in 1980 to 44.3% in 1989. Newspaper circulations are increasing very slowly—about 1% in 1987—and publishers face external pressures, such as consolidation among retailers and a softening in financial advertising. Over the long term, Giroux said, newspapers must fight local TV and radio for a share of retailers' growing expenditures.

Direct mail, the fastest-growing print segment, accounted for $23.2 billion in 1989—an increase of 206% since 1980. Giroux said direct mail will continue to drive the entire print category. In Canada, it has overtaken television as the No. 2 medium behind newspapers. Direct mail accounts for 31.4% of all print expenditures—up from 25.1% in 1980. Its customer base is growing and now includes packaged-goods companies, such as Kimberly Clark Corp. and General Foods. This growth also pushes up demand for higher-quality, higher-impact packages. Attention-grabbing techniques include 3-D designs and holography.

Growth in spending for magazines has slowed, reaching $9.6 billion in 1989. Yet, spending grew 94% during the 1980-89 period. Magazines have lost market share, which declined from 16.4% in 1980 to 13.0% in 1989. Over half the loss was suffered by trade magazines because of increased use of direct mail. Consumer magazines have also lost share, Giroux said. Nevertheless, advertising expenditures for magazines are expected to double during the 1990s.

Yellow pages make up the smallest segment of the print market, with $8.4 billion in 1989 spending and decade-long growth of 188%. The directory publishing industry has undergone a shakeout, with many independent publishers folding or selling out to the RBOCs, but ad revenues will be boosted by better-quality paper and the fact that yellow pages represent direct marketing to "qualified" customers.

Another area of growth is catalogs. Mail-order sales have increased at more than double the rate of retail sales for several years, according to Conrad Cudzewicz, advertising controller for Spiegel Inc. This growth is being spurred by a growing number of women in the work force as well as the maturing of the baby-boom generation, which comprises one-third of the population and wields increasing economic power. By 1995, 80% of baby-boom women will be working; when added to their other concerns of family and home, this gives them little time for conventional retail shopping.

Cudzewicz believes the print medium will remain the dominant form of advertising communication because of its convenience, as opposed to computer shopping or televised home-shopping programs.

Denis Gosselin, editor of the *Chicago Tribune Magazine*, told Groundwood Conference delegates that Sunday magazines have experienced declining revenues. The number of such weekly magazines has dropped from 58 in 1983 to 47 in 1988. Among the casualties were magazines at the *Atlanta Journal*, *Columbus* (Ohio) *Dispatch*, *Houston Post*, *Sacramento Bee*, *Dayton* (Ohio) *Daily News*, *Dallas Times Herald*, and *Denver Post*.

Free-standing advertising inserts have increased, along with multiple-sectioning and zoned editions of the parent newspapers. Many newspapers have linked up with the national Sunday magazines, *Parade* and *USA Weekend*, drawing ads from the local versions. Sunday magazines also suffered from growth in targeted consumer magazines, such as city magazines. Other competition comes from the national daily newspapers: *USA Today*, *National Sports*, and *Newsday*, which Gosselin said are really magazines.

Sunday magazines are no longer unique, he said. Thus, half of them are losing money and one-fourth are barely breaking even. Gosselin foresees a continuing shakeout, during which local Sunday magazines will be further displaced by *Parade* and *USA Weekend* as well as local or regional syndication of certain publications.

Despite the pressure to trim costs at Sunday magazines, downsizing them to 8 1/4 x 10 3/4 did not catch on. Publishers instead are looking toward the so-called "Part 2s," which are free-standing, single-topic magazines that run concurrently with the main Sunday magazine. The *New York Times* runs about 19 per year, while the *Chicago Tribune* publishes about nine annually. A less local Part 2 is *Good Health*, which resulted from a network of the *New*

UNCOATED GROUNDWOOD PAPER: U.S. EXPORTS AND IMPORTS

(000 short tons)

Year	Exports[1]	Imports[2]
1989	71	1,470
1988	66	1,404
1987	56	1,270
1986	41	1,527
1985	37	1,387
1984	30	1,298
1983	37	920
1982	56	653
1981	120	650
1980	101	688
1979	80	695
1978	58	611
1977	54	443
1976	71	338
1975	74	84
1974	53	110
1973	29	120
1972	18	142
1971	10	156
1970	7	218

1. Prior to 1978, Census classification was groundwood paper, printing, writing and converting, uncoated. From 1978, classification was printing and writing papers, over 10% mechanical pulp, uncoated.
2. Prior to 1978, Census classification was uncoated book and printing paper with over 25% mechanical pulp. From 1978, classification was the same except for mechanical pulp content, which was reclassified as over 10% mechanical pulp.
Source: Bureau of the Census.

York Times, *Los Angeles Times*, *Chicago Tribune*, *Boston Globe*, and *Washington Post*. All five issues of *Good Health* were printed on the same stock at the same size by the same printer. Each carried local editorial copy, but advertising was sold cooperatively, giving advertisers a choice in any combination of the five major U.S. markets.

UNCOATED GROUNDWOOD PAPERS: U.S. PRICE HISTORY

($/ton, year end)

Year	Directory[1] (22.5-lb white)	SC-A (34-lb)	Premium roto news	Forms 15-lb	MF offset 35-lb
1990					
2Q	$(730)/780*	$(800)/830	$(635)/675	$680-720	$(635)/675
1Q	(730)/780*	830*	(635)/675	680-720	(635)/675
1989					
4Q	(730)/780*	830*	(635)/675	680-720	(635)/675
3Q	(730)/780*	830*	(635)/675	680-720	(635)/675
2Q	850*	830*	680*	680-720	675*
1Q	850	830	680	720	675*
1988					
4Q	850	830	680	720	675
3Q	780	830	680	690/700	660
2Q	780	780	680	690/700	660
1Q	750	780	652	640	652
1987					
4Q	720	740	600-620	600	575-585
3Q	703	710	553	560	577
2Q	670	670	517	540	570
1Q	(620)/670*	670	517*	540	535*
1986					
4Q	670	710	570	540	535*
3Q	670	710	540	540	535*
2Q	670	780*	540	500*	535*
1Q	670	780*	540	500*	545
1985					
4Q	670	780*	540	500*	542
3Q	670	780*	540	500*	545
2Q	670	780	567	525	525
1Q	670	780	580	545	545
1984	670	735	560	500	520
1983	650	645	540	n.a.	n.a.
1982	650	635	515/520	n.a.	n.a.
1981	578	n.a.	500/515	n.a.	n.a.
1980	535	n.a.	475	n.a.	n.a.
1979	480	n.a.	404	n.a.	n.a.
1978	420	n.a.	350/375	n.a.	n.a.
1977	n.a.	n.a.	330	n.a.	n.a.

*Discounting off list price.
n.a. = Not available.
1. Reflects open market sales, not contract tonnage to regional Bell operating companies (RBOCs).
Sources: *Pulp & Paper Week*, *Pulp & Paper Pricebook2*.

Paper:

COATED

Coated papers are categorized in several ways. The first is division by coating—coated one side (C1S) or coated two side (C2S). The second way is according to whether or not they contain groundwood pulp (coated groundwood and coated free-sheet). Paper with 10% or more mechanical pulp is designated coated groundwood; paper with less than 10% is coated free-sheet. Coated groundwood papers are often referred to as lightweight coated (LWC), though basis weights for LWC are typically 40 lb or less (sometimes 45 lb), while basis weights can actually go much higher. Mills can classify papers as they wish, and recent advancements in intermediate grades from Europe help muddy distinctions even further.

Demand for C1S paper has been slowly declining, dropping somewhere near 2% in 1989 from 1988, though essentially retaining 6% of the total U.S. coated paper market and 13% of coated free-sheet production. About 85% of C1S paper is used for labels; the rest is divided among books, commercial printing, business forms, envelopes, and converted products other than labels. Meanwhile, C2S papers are used primarily for magazines, catalogs, advertising brochures and inserts, and other commercial printing.

Further coated paper grade classifications range from superpremium, the most expensive and highest-quality sheet, to No. 5, the lowest in quality and price. Superpremium and Nos. 1 to 3 are made from chemical pulps (free-sheet). Roughly half of No. 4 papers produced contain a large amount of mechanical pulp (groundwood). No. 5, with rare exceptions, always contains a high percentage of mechanical pulp. No. 5 papers make up about 49% of total coated paper produced, about 3.5 million tons in 1989. Mills have some leeway in designating their paper grades. For example, some mills may call a higher-quality No. 1 grade "premium" or "superpremium" and omit the No. 1 designation. Other mills may say "premium No. 1."

Each successively higher-quality grade is produced in smaller tonnages than the one before it. For instance, in 1989, No. 1 represented somewhat more than 6% of total U.S. coated paper production. No. 2 was almost 7%, No. 3 was about 13%, and No. 4 was almost 19%. Just about 50% of all No. 4 paper is coated groundwood, and the trend until

U.S. STATISTICS FOR COATED GROUNDWOOD PUBLICATION PAPERS

	1990e	1989	1988r	1987	1986	1985
Production,[1] 000 tons	4,141	4,001	4,159	3,782	3,478	3,410
Capacity,[2] 000 tons	4,607	4,467	4,347	4,136	3,799	3,820
Utilization rates, %	89.9	89.6	95.7	91.4	91.6	89.3
Imports, 000 tons	522	497	507	500	401	393
Exports, 000 tons	121	116	46	39	36	44
Apparent U.S. consumption						
000 tons	4,542	4,382	4,620	4,243	3,843	3,759
lb/capita	36.28	35.17	37.45	34.91	31.91	31.50
000 tons/billion $ real GNP (1982)	1.08	1.06	1.16	1.10	1.03	1.04

e = Estimate.
r = Revised.
1. *Pulp & Paper* estimates.
2. American Paper Institute capacity for coated groundwood papers; includes coated grade No. 5 and some No. 4.

1989 was toward increasing the free-sheet end of the grade. No. 5's market share has declined during the past two decades (except for 1989), but actual tonnage has risen dramatically.

Canada only recently expanded its presence in coated papers, and comparable breakdowns are not yet available. But by year-end 1989, coated paper accounted for slightly more than 15% of total printing/writing papers production (uncoated groundwood, uncoated free-sheet, and coated). This level was down from 17% in 1988 and 16% in 1987, probably due to market conditions. Capacity is increasing substantially with the startups of machines by Repap Enterprises Inc.

Basis weights for premium coated grades—Nos. 1 and 2—generally range from 60 to 100 lb. Nos. 3 and 4 are offered in basis weights of 25 to 90 lb. Commercial printers are the biggest users of coated free-sheet. End uses include annual reports, catalogs, other advertising and promotional materials, and cover and interior pages of upscale magazines, with some used in "coffee table" books. In 1989, about 12% of No. 3 production went to magazine publishers, and 68% went to commercial printers.

Coated groundwood papers are commonly made in the 32-to-50-lb range (25 x 38 in. in reams of 500), although basis weights can run as low as 30 lb and as high as 70 lb. End uses include magazines, Sunday newspaper supplements, catalogs, newspaper inserts, directories, books, and flyers. Coating weight is approximately 30% of total sheet weight for LWC papers.

Different printing methods, such as letterpress, offset, and rotogravure, require specific paper sizes, though some papers can run satisfactorily on more than one printing pro-

U.S. STATISTICS FOR COATED FREE-SHEET PUBLICATION PAPERS

	1990e	1989	1988	1987	1986	1985
Production,[1] 000 tons	3,463	3,297	3,200	3,085	2,781	2,465
Capacity,[2] 000 tons	3,892	3,675	3,436	3,229	2,944	2,845
Utilization rate, %	89.0	89.7	93.1	95.5	94.5	86.6
Imports, 000 tons	135	127	119	114	100	103
Exports, 000 tons	52	50	62	57	42	39
Apparent U.S. consumption						
000 tons	3,546	3,374	3,257	3,142	2,839	2,529
lb/capita	28.32	27.08	26.40	25.85	23.58	21.20
000 tons/billion $ real GNP (1982)	0.84	0.81	0.81	0.82	0.76	0.70

e = Estimate.
r = Revised.
1. *Pulp & Paper* estimates.
2. American Paper Institute survey.

TYPICAL PROPERTIES OF COATED PUBLICATION GRADES

General characteristics	Typical use	Basestock	Coating	Brightness
No. 1: Enameled, double-coated, hand-sorted expensive base and coating; high gloss; basis weight above 70 lb	Annual reports	High-brightness chemical pulp; heavily filled	High in TiO_2; high gloss enameled; synthetics	82-88
No. 2: Double-coated, expensive base and coating	Expensive advertising	High-brightness chemical pulp; filled (clay)	High in TiO_2; some clay; synthetics	78-82
No. 3: Single- or double-coated, lower-quality basesheet	Advertising	Chemical pulp; minor amounts of groundwood	Mostly clay, some TiO_2 less expensive	76-82
No. 4: Lower cost, lower brightness	Magazine	Groundwood and chemical pulp; some clay filler	Less expensive; coating—clay and TiO_2	72-78
No. 5: Lower basis weight, high groundwood content	Directories, catalogs, magazines	Mostly groundwood or TMP, chemical pulp for runability	Variable, some contain synthetics	68-72

cess. Offset printing, particularly heatset, has grown rapidly in importance, and offset papers represent the largest portion of C2S publication papers—between 75% and 80%. Letterpress accounts for less than 10%, and gravure makes up most of the balance.

Offset printing requires a smooth surface and pick resistance. Letterpress is slightly less demanding in terms of paper-surface properties, but it generally needs heavier basis weights because of strike-through in low-basis-weight papers. Gravure printing is often used for long press runs that require paper with a smooth surface and controlled ink receptivity.

Mills installing a new machine or substantially rebuilding existing equipment have the choice of on-machine or off-machine coating equipment. A smaller, older mill might find it easier to use an off-machine coater that can simply be shut down when the mill needs to make uncoated paper. During the coating process, one station applies coating to one side, although the same station can be used to apply coating simultaneously to both sides. Mills may also have coating equipment that applies two coats on the same side, or a precoat may be applied to smooth out surface roughness. These processes are separate from the coating that a printer may add during or after the printing run. This adds an even glossier surface to the paper (e.g., magazine covers), and it can be done inline (UV) or later, which is more expensive.

Coating solutions are comprised of pigments (kaolin clay, titanium dioxide, or calcium carbonate), binders, and additives to control viscosity and other rheological properties. Delaminated clay is increasingly being used, especially in LWC papers. These coatings provide better runability when combined with conventional kaolins.

Water comprises as much as 50% of a coating formulation, and the excess must be dried quickly and efficiently by through-air, drum, and infrared drying. Once the excess water is removed, the coated sheet is supercalendered if a glossy finish is desired, and it may be supercalendered through the nip of many rolls to further develop the surface gloss. If a high-gloss finish is required, as it is with an enameled sheet, a gloss calender is used. Dull-finish and matte-finish papers are made by curtailing the use of supercalenders. Dull-finish paper gets little or no pressure from the supercalender. Matte-finish paper goes through a supercalender with one stack that has been sandblasted or engraved to imprint the matte appearance. Matte-finish paper gives a gloss test reading of 20 or less, while dull-finish paper can reach 45 or 55 on the gloss scale. Glossy finish is higher. Probably about 90% of C2S paper is glossy, about 10% matte, 3% dull, and a small amount embossed. Between 85% and 90% of coated paper is shipped in rolls rather than sheets.

INDUSTRY STRUCTURE

Ten leading coated groundwood producers represent nearly 83% of North American capacity. In coated free-sheet grades, the top ten mills account for some 90% of total industry capacity. More than 60% of North American coated paper capacity is controlled by the top five companies. Major coated free-sheet producers are Scott Paper Co., Westvaco Corp., Mead Corp., Consolidated Papers Inc., and Potlatch Corp. The five largest coated groundwood producers are International Paper Co., Champion International Corp., Consolidated Papers, Repap Enterprises Inc., and Boise Cascade Corp.

Most new major coated groundwood capacity had been brought online by the end of 1990, with the next major addition—Boise's 320,000-tpy machine at Rumford, Maine—scheduled for completion in 1993. A number of machines have been proposed but delayed in 1989 and 1990 because of weaker market conditions. These potential projects in-

U.S. COATED PAPER PRODUCTION

(000 short tons)

Year	Total coated[1]	Coated one side[2]	Coated two side[2] Total	Nos. 1-4	No. 5
1989	7,194	415	6,779	3,246	3,533
1988r	7,364	423	6,941	3,325	3,616
1987	6,859	422	6,437	3,117	3,320
1986	6,260	385	5,875	2,755	3,120
1985	5,860	360	5,500	2,520	2,980
1984	6,249	390	5,860	2,670	3,190
1983	5,675	390	5,285	2,320	2,965
1982	4,970	365	4,605	2,025	2,580
1981	4,880	395	4,485	2,035	2,450
1980	4,615	375	4,240	1,840	2,400
1979	4,642	410	4,230	2,080	2,150
1978	4,593	440	4,155	2,000	2,155
1977	4,274	415	3,860	1,640	2,220
1976	3,890	410	3,480	1,490	1,990
1975	3,076	330	2,740	1,120	1,620
1974	3,739	410	3,330	1,650	1,680
1973	3,757	435	3,320	1,430	1,890
1972	3,455	400	3,055	1,040	2,015
1971	3,165	360	2,805	905	1,900

r = Revised.

1. Shipments for both one- and two-side coated papers.

2 *Pulp & Paper* estimate. May not add to "Total coated" due to rounding.

clude 250,000-tpy machines at Blandin Paper Co. in Grand Rapids, Minn., and Bowater Inc. in Calhoun, Tenn.; 273,000 tpy formerly proposed as a joint venture between Great Northern Nekoosa Corp. and German papermaker M.D. Papier in Millinocket, Maine; and an unspecified machine by Fraser Paper Ltd. in Madawaska, Maine. Projects are also under study by Champion at Sartell, Minn., and James River Corp. at St. Francisville, La.

Coated free-sheet capacity is another matter, with three major projects coming online in 1990/91. These are Champion's 265,000-tpy machine at Quinnesec, Mich., due for startup in fourth-quarter 1990 (when Scott Paper's new 215,000-tpy machine at Skowhegan, Maine, also will come online) and 212,000 tpy of paper at Consolidated Papers' Wisconsin Rapids, Wis., Div., scheduled for startup in 1991.

Canadian mills continued to add capacity, particularly Repap, which has increased both coated groundwood and coated free-sheet capacity over the past few years, becoming one of the largest North American producers of coated papers. Canadian coated free-sheet capacity in 1989 was approximately 132,000 short tpy and rose to 165,000 tpy in 1990. Projected 1991 capacity is 182,000 tpy, climbing to 209,000 tpy in 1992, according to the Canadian Pulp & Paper Assn. Coated groundwood capacity in Canada is much more substantial. It was 419,000 tpy in [illegible]989 and 584,000 tpy in 1990, and it is projected to rise to 645,000 tpy in 1991 and 678,000 tpy by 1992.

U.S. imports of Canadian coated grades were about 537,000 short tons in 1989, a slight rise from the 529,000 tons shipped to the U.S. in 1988, according to CPPA. Most of that tonnage was coated groundwood.

TRENDS IN LWC PUBLICATION GRADES

LWC papers usually have basis weights of 40 lb or less, though some companies include up to 45 lb in the category. Most of the LWC paper produced in North America is used in consumer and trade magazines and catalogs; therefore, demand for LWC paper follows trends in magazines and catalog-related retail businesses. Companies tend to announce capacity additions when markets are good, but the capacity often comes online when the markets (or at least paper prices) are down, such as in 1986-87 and 1989-90. Magazines have suffered declining ad pages for a number of years, including 1985, 1986, 1987, and the first half of 1990. Coated groundwood as a percentage of total magazine tonnage has been declining slightly, though the total amount of paper continues to increase. In 1989, coated groundwood papers represented 73% of all paper consumed by domestic magazines, but that will drop to 72% in 1990 and 1991, according to the Magazine Publishers of America (MPA). Magazine publishers and printers purchase about 51% of the total coated groundwood paper produced in the U.S.

NEW NORTH AMERICAN COATED PAPER CAPACITY THROUGH 1993

Company, U.S.	Location	Annual short tons	Grade	Startup
Blandin Paper	Grand Rapids, Minn.	221,000 net	CGW	1989
Potlatch	Cloquet, Minn.	No increase	CF	1989
Champion International	Bucksport, Maine	n.a.	CGW	1989
Wausau Paper Mills	Rhinelander, Wis.	25,000		1989
Champion International	Quinnesec, Mich.	265,000	CF	1990
Westvaco	Wickliffe, Ky.	100,000	CF	1990
S.D. Warren/Scott Paper	Skowhegan, Maine	215,000	CF	1990-91
Weyerhaeuser	Columbus, Miss.	n.a.		n.a.
International Paper	Various	200,000	CF	1988-92
Consolidated Papers	Wisconsin Rapids, Wis.	212,000	CF	1991
Boise Cascade	Rumford, Maine	318,000	CGW	1993
Blandin Paper	Grand Rapids, Minn.	220,000	CGW	Postponed
G-P/MD Papier	Millinocket, Maine	n.a.	CGW	Postponed
Bowater	Calhoun, Tenn.	240,000	CGW	Postponed
Fraser	Madawaska, Maine	n.a.	CGW	Postponed
James River	St. Francisville, La.	n.a.		Under study
Mead	Unknown	n.a.	CF	Under study
Company, Canada	**Location**	**Annual metric tons**	**Grade**	**Startup**
Repap Enterprises	Newcastle, N.B.	200,000-260,000	CF/CGW	1989
Island Paper Mills	New Westminster, B.C.	75,000		1990
Malette/Rexfor(1)	St-Raymond, Que.	70,000	CGW	1990-92
Repap Enterprises	Prince Rupert, B.C.	200,000		Under study
Makin Pulp & Paper	Britannia Beach, B.C.	140,000		Proposed

North American capacities, 1990
U.S.: 8.499 million short tpy
Canada: 685,000 metric tpy

n.a. = Not available.
1. Former St-Raymond Paper newsprint, specialties mill. Will produce machine-finish coated paper.
Sources: *Pulp & Paper Week*, *Pulp & Paper Project Report*.

Major magazine publishing companies expect to increase paper use only 0.8% this year compared with last year, but they predict demand will rise 4.3% in 1991, an industry survey indicates. Publishers continue the trend toward lighter basis weights at the low end and higher basis weights at the high end of the market. Coated groundwood papers will retain their 68% share of the magazine paper market, according to the latest MPA paper survey of 69 publishers representing 323 titles.

MPA's "Paper Outlook" report suggests that publishers in 1990 will expand their use of offshore paper as a percentage of the 1.674 million tons of paper overall. Demand for non-North American coated groundwood will advance 17.8%, supercalendered (SC) by 17.9%, and other uncoated groundwood nearly 15%. At the same time, North American coated groundwood paper demand will fall 1.2% this year, while SC will rise 3.2%, and other uncoated groundwood will advance 4.3%. The 194,000 tons of coated and uncoated free-sheet grades come primarily from North American mills.

Those predictions change slightly for 1991, particularly with uncoated groundwood from overseas, which is expected to decline 28.2% that year. North American SC papers will lose ground, increasing only 0.5% compared with this year. Local coated groundwood grades will post a gain of 3.9% over 1990.

Publishers will increase their use of 32-lb and 40-lb, at the expense of weights in between. The biggest jump to 32-lb comes this year, rising from 3.67% of total tonnage in 1989 to 12% this year and 16.4% next year, MPA said. Though not as dramatic, 40-lb paper as a percentage of total tonnage used will increase from almost 22.1% in 1989 to 24.3% this year and 25.2% next year. Both 34- and 36-lb weights will lose market share, the survey suggested. Among the magazines that have switched from 34-lb to 32-lb are *Time* and *Newsweek*.

Coated paper has not always lost market share to its cheaper cousin, SC paper, though that grade became an acceptable competitor in the early 1980s during a paper shortage. K-Mart Corp., Sears Roebuck & Co., and other retailers used rotonews and SC papers more liberally in their catalogs and advertising, though for magazines SC is still considered an unlikely pretender to coated groundwood's throne. Still others moved from coated groundwoods to No. 4 coated free-sheet grades when those prices weakened in 1987 and 1989-90.

As mechanical integrity of the sheet (i.e., flawlessness) becomes more important, new papermaking technologies have developed. These technologies enhance runability and printing characteristics such as ink holdout and ink gloss, which are more important to publishers than opacity.

With the drop in basis weights below 36 lb, mills must

NORTH AMERICAN COATED PAPER CAPACITY

(000 short tons)

Year	Coated free-sheet	Change (%)	Coated groundwood*	Change (%)
U.S.				
1992p	4,735	10.6%	4,668	1.0%
1991p	4,282	10.0	4,621	0.3
1990p	3,892	5.9	4,607	3.1
1989	3,675	7.0	4,467	2.8
1988	3,436	6.4	4,347	5.1
1987	3,229	9.7	4,136	8.9
1986	2,944	3.5	3,799	-0.5
1985	2,845	1.9	3,820	1.4
1984	2,791	12.9	3,766	6.9
1983	2,473	8.9	3,522	6.3
1982	2,271	2.1	3,312	8.7
1981	2,225	0.1	3,047	10.3
1980	2,222	0.[illegible]	2,762	10.0
1979	2,214	5.6	2,511	2.5
1978	2,096	5.4	2,450	1.7
1977	1,989	4.5	2,408	4.7
1976	1,903	-1.8	2,299	8.1
1975	1,938	—	2,127	-47.8
1974	—	—	4,075	0.7
1973	—	—	4,045	4.6
1972	—	—	3,866	2.3
1971	—	—	3,778	2.1
1970	—	—	3,700	-0.9
1969	—	—	3,732	—
Canada				
1992	209	14.8	678	5.1
1991	182	10.3	645	10.4
1990	165	25.0	584	39.4
1989	132	0.0	419	10.3
19[illegible]	132	n.a.	380	n.a.

*Includes all coated paper capacity until 1975.
p = Preliminary.
n.a. = Not available.
Source: American Paper Institute.

MAJOR NORTH AMERICAN COATED FREE-SHEET PRODUCERS

(1990 estimated capacities)

		Annual capacity (000 tons)	Capacity share (%)
1.	Scott Paper[1]	900	22.3%
2.	Westvaco	580	14.3
3.	Mead	380	9.4
4.	Consolidated Papers[2]	330	8.2
5.	Potlatch	300	7.4
6.	Simpson Paper[2]	290	6.5
7.	Champion International[3]	264	7.1
8.	Repap Enterprises	240	5.9
9.	Noranda Forest	194	4.8
10.	James River	148	3.7

North American capacity (1990): 4.042 million tons
(Canada estimate: 15,000 short tons)
Capacity share of top five companies: 61.6%
Capacity share of top ten companies: 89.7%

e = Estimate.
1. S.D. Warren Div.
2. *Pulp & Paper* estimate.
3. 1989 production.

reduce the weight of both the basestock and the coating. Different coating mixtures and new lightweight chemical compositions allow some mills to make the reductions in coat weight—going to a 6-lb coating formulation, for example, from a 10-lb or higher formulation. Other mills reduce the weight of the basestock by a greater percentage. Some mills can use a lighter-weight basesheet than other mills. Surface smoothness is the deciding factor.

Adding kraft fiber can increase strength, helping to reduce breaks in web printing. Groundwood fiber reduces cost, maintains opacity and surface smoothness, and supplies much of the sheet's fiber content.

Thermomechanical pulp (TMP) and chemi-thermomechanical pulp (CTMP) have received wide industry attention as alternatives to stone groundwood pulp. The TMP process produces fibers that are better separated than groundwood pulp fibers, and they have the added benefit of retaining much of their original length. Thus, TMP fibers hold together better, adding strength to the finished paper. CTMP has a tensile strength that is about equal to chemi-mechanical pulp and higher than TMP, plus it has a higher tear factor. CTMP paper normally has a lighter color than TMP.

Various industry observers believe International Paper chose a variation of CTMP for its new coated groundwood mill at Pine Bluff, Ark. That mill uses "chemically enhanced groundwood" for its basesheet, although the process reportedly encountered some initial production problems. If papermakers had their way, most of them would use titanium dioxide as a coating material, especially for LWC, because of its superior opacity. But TiO_2 pricing is volatile and has been running high in recent years. Kaolin clays remain the most widely used coating by volume—about 4 million tons used in 1987 compared with 200,000 tons of TiO_2. When TiO_2 is used, such as with delaminated grades, the balance of coating material content is specialized clay: calcium carbonate, hydrated alumina, plastic pigment, talc, and zinc oxide.

MAJOR NORTH AMERICAN COATED GROUNDWOOD PRODUCERS

		Annual capacity (000 tons)	Capacity share (%)
1.	International Paper[1]	645	12.5%
2.	Champion International[2]	607	11.7
3.	Consolidated Papers[1]	580	11.2
4.	Repap Enterprises	520	10.0
5.	Boise Cascade	390	7.5
6.	Bowater	350	6.8
7.	Mead	335	6.5
8.	James River	315	6.1
9.	Blandin Paper[3]	311	6.0
10.	Pentair[4]	220	4.2

North American capacity (1990): 5,180 million tons
U.S.: 4.607 million short tons
Canada: 573,000 short tons
Capacity share of top five companies: 52.2%
Capacity share of top ten companies: 82.5%

1. *Pulp & Paper* estimate.
2. 1989 production.
3. Subsidiary of Fletcher Challenge Canada Ltd.
4. Niagara, Wis.

A massive amount of CTMP capacity is already online or scheduled for startup in North America. Producers will try to convince customers to add it to kraft pulp for reduced costs or to mechanical pulp for increased brightness and strength.

Use of recycled fibers for coated groundwood papers is still severely limited, though several mills are starting to consider or even introduce some recycled grades. Already on the market is one publication grade from Simpson's Plainwell Div. Pentair's Niagara Paper reportedly also is considering introducing a recycled coated groundwood.

OUTLOOK FOR COATED PAPERS

Nos. 1, 2, and 3 grades will experience strong growth in the near term. Producers such as Consolidated Papers, Potlatch, and Westvaco have already introduced new premium or superpremium No. 1 grades that possess better reproduction qualities and have higher prices than the established

MAJOR NORTH AMERICAN COATED PAPER PRODUCERS

(1990 estimated capacities)

	Annual capacity (000 tons)	Capacity share (%)
1. Consolidated Papers[1]	900	9.8%
2. Scott Paper[2]	900	9.8
3. Champion International[3]	980	10.6
4. Repap Enterprises	940	10.2
5. Mead	705	7.6
6. International Paper	650	7.0
7. Westvaco	580	6.3
8. James River	463	5.0
9. Potlatch	311	3.4
10. Simpson Paper[1]	290	3.1
11. Boise Cascade	390	4.2
12. Bowater	350	3.8
13. G-P/GNN	165	1.8

North American capacity (1990e): 9.222 million tons
Capacity share of top five companies: 48.0%
Capacity share of top ten companies: 72.9%

e = Estimate.
1. *Pulp & Paper* estimate.
2. S.D. Warren Div.
3. 1989 production.
Source: Dean Witter Reynolds Inc.

No. 1 papers. European producers also have entered the market; they currently supply about 8% of total U.S. demand for Nos. 1, 2, and the superpremium grades.

No. 2 will increase its share of the coated market to nearly 5%. No. 3 will grow 5.7% annually because it is produced mostly at integrated kraft mills, which have distinct cost advantages. For a minor price increase, end users can upgrade from No. 4 grades, which are normally produced at mills that must purchase kraft pulp. Demand for No. 4 free-sheet will increase faster than demand for No. 4 groundwood. CIS paper, which is used primarily for labels, is forecast to grow only 0.7% annually.

Historical pricing trends ($/short ton, average price for year) for coated free-sheet (70-lb No. 1 sheets) are as follows: 1985, $1,375; 1986, $1,350; 1987, $1,410; 1988, $1,509; 1989, $1,614. The following are historical prices for No. 3 rolls: 1985, $980; 1986, $945; 1987, $980; 1988, $1,115; 1989, $1,258.

Strong demand and tight markets caused prices for coated groundwood papers to rise in 1988, as they did in 1987, but discounting was fairly rampant in 1989 and the first half of 1990.

Historical pricing trends ($/short ton, year end) for coated groundwood papers (34-lb No. 5 roto paper) are as follows: 1985, $931; 1986, $860; 1987, $890; 1988, $990; 1989, $966 (transaction).

Jeanne Carroll, an analyst with Morgan Stanley & Co. Inc., told delegates at *Pulp & Paper*'s Groundwood Papers Conference that coated groundwood paper capacity will advance about 4.0% in 1990, 1.3% in 1991, and 1.0% in 1992. She said consumption will grow about 4.0% in 1990, 4.1% in 1991, and 5.5% in 1992, leading to operating rates of 90.3%, 92.1%, and 95.6%, respectively.

North American mills may face stiffer competition from producers in Europe because of excess capacity there. In fact, an abundance of new capacity in newsprint and uncoated and coated mechanical paper grades is likely to cause operating rates at European mills to drop below 80% during the next few years, according to the European Paper Institute's (EPI) "Paper Capacity Report for Woodcontaining Publication Papers in Reels." The report's summary indicates that from 1988 to 1993, net production capacity of these grades will increase by about 4 million metric tons—a 28% overall growth rate. This does not include planned projects awaiting final approval, which could add another 1.5 million tons. Half of the total capacity increase will be in coated mechanical grades, including the lightly pigmented papers or intermediate grades.

Strong economic growth in Europe and better-than-

U.S. PRICES FOR COATED PUBLICATION PAPERS

($/short ton)

Year	No. 1 70 lb, sheets	No. 3 60 lb, rolls	No. 4 50 lb, rolls	No. 5 34 lb roto, rolls	No. 5 40 lb, rolls
1990					
2Q	$1,610-1,640*	$1,270*	$(890)/940	$(940)/990	$(820)/880
1Q	1,610-1,640*	1,270*	(900)/940	(960)/990	(850)/880
1989					
4Q	1,610-1,640*	1,270*	(900)/940	(960)/990	(850)/880
3Q	1,610-1,640*	1,270*	(900)/940	(960)/990	(850)/880
2Q	1,610-1,640	1,270	(920)/940	(950)/990	(840)/880
1Q	1,560-1,600	1,220	940-950	990-1,000	880-900
1988					
4Q	1,560-1,600	1,220	940-950	990-1,000	880-900
3Q	1,560-1,600	1,120	940-950	990-1,000	880-890
2Q	1,450	1,060	890	940	830/840
1Q	1,450	1,060	890	940	830
1987					
4Q	1,440-1,460	1060	840	890	790-800
3Q	(1,400)/1,415	1022	820	847	740
2Q	(1,390)/1,415	(945)/1,020	(740)/760	(760)/787	(640)/680
1Q	1,415*	(945)/1,020	(740)/760	(760)/787	(640)/680
1986					
4Q	1,375	980	760	860*	745
3Q	1,375	980	807	860*	(765)
2Q	1,375	980	880*	888*	798*
1Q	1,375	980	860*	902*	813*
Year end					
1985	1,375	980	880	931	842
1984	1,318	921	777	860	818
1983	1,250	830	661	782	n.a.
1982	1,200	798	690	760	n.a.
1981	1,130	798	n.a.	760	n.a.
1980	1,038	750	n.a.	735	n.a.
1979	970	690	n.a.	671	n.a.
1978	893	621	n.a.	573/590	n.a.
1977	n.a.	600	n.a.	520/545	n.a.
1976	n.a.	540	n.a.	460	n.a.
1975	n.a.	486	n.a.	399	n.a.
1974	n.a.	475	n.a.	400	n.a.
1973	n.a.	n.a.	n.a.	285	n.a.

*Discounting off list price reported.
n.a. = Not available.
Sources: *Pulp & Paper Week, Pulp & Paper Pricebook2.*

expected imports to the U.S. helped push demand for publication paper grades higher than previously forecast, EPI said. However, the outlook for growth in the next five years "is less robust than in the recent past," due to increasing inflation, higher interest rates, and signs of softness in the U.S. economy. "Based on average economic growth of about 2.5%/year and continued growth in exports, deliveries of newsprint are expected to increase at 2%/year, SC magazine at 1%, coated mechanical reels at 5.5%, and other uncoated at 5%/year for the next five years," the report said.

Coated mechanical grades could be hit hardest, based on figures from the EPI's July 1990 "Paper Capacity Report on Woodcontaining Publication Papers in Reels." Utilization rates could drop from about 92.5% in 1989 to a low of 82.9% in 1991, the figures indicate. Capacity for coated mechanical papers will increase 25.7%, or more than 1.3 million metric tons, or almost half of the total increase in capacity from 1990 to 1994, EPI said.

North American consumption of coated paper was almost 8.2 million tons in 1988, dropping slightly to 8.0 million tons in 1989, and is projected to climb to 8.3 million tons in 1991. Annual growth will be about 4.5%, and capacity utilization will fall below 90% in 1990-91.

Consumption by catalog publishers will stabilize at slightly higher than 5%/year. Targeted mailings will help reduce waste, and publishers are cutting costs through better coordination of paper purchasing and scheduling. Conrad Cudzewicz, advertising controller at Spiegel Publishing Co., said, "Catalog paper procurement at Spiegel currently exceeds $45 million annually."

COATED PAPER SHIPMENTS TO MAGAZINE PUBLISHERS

(000 short tons)

Year	Coated two side paper Total	Nos. 1-4	No. 5	All grades[1]	Coated imports[2]
1989	2,436	899	1,537	2,436	774
1988r	2,510	926	1,584	2,510	798
1987	2,420	622	1,798	2,903	675
1986	2,428	527	1,901	2,432	501
1985	2,275	448	1,827	2,299	496
1984	2,397	498	1,899	2,428	428
1983	2,290	470	1,820	2,450	162
1982	2,010	425	1,585	2,130	69
1981	2,009	408	1,601	2,185	36
1980	1,969	405	1,564	2,125	115
1979	1,838	400	1,438	2,017	189
1978	1,902	365	1,537	2,054	214

r = Revised.
1. Includes C1S. No C1S shipped in 1988 and1989.
2. Includes nonmagazine shipments.
Source: *Pulp & Paper* estimates.

U.S. ADVERTISING VOLUME

(million $)

Medium	1988	1989	Change (%)
Newspapers	$31,197	$32,368	3.8%
Magazines	6,072	6,716	10.6
Farm publications	196	212	8.2
Television	25,686	26,891	4.7
Radio	7,798	8,323	6.7
Yellow Pages	7,781	8,330	7.1
Direct mail	21,115	21,945	3.9
Business papers	2,610	2,763	5.9
Outdoor	1,064	1,111	4.4
Miscellaneous	14,531	15,271	5.1
Total	118,050	123,930	5.0

Source: Prepared for *Advertising Age* by Robert J. Coen, McCann-Erickson.

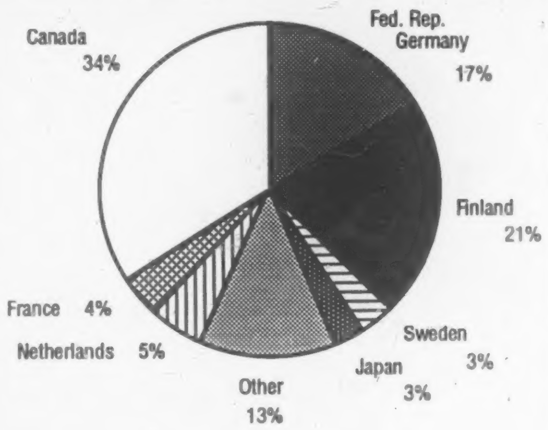
PAPER SHIPMENTS TO COMMERCIAL PRINTERS

(000 short tons)

Year	Coated two side paper Total	Nos. 1-4	No. 5	Uncoated free-sheet	Uncoated groundwood	Total
1989	3,044	2,283	761	2,800	379	6,223
1988	3,009	2,256	753	2,857	306	6,172
1987	2,842	2,140	702	2,735	177	5,754
1986	2,469	1,900	569	2,570	202	5,241
1985	2,240	1,760	480	2,430	250	4,920
1984	2,400	1,830	570	2,350	280	5,030
1983	2,075	1,535	540	2,165	245	4,485
1981	1,720	1,300	420	1,950	175	3,845
1980	1,605	1,200	405	2,000	220	3,825

Source: *Pulp & Paper* estimates.

U.S. COATED PAPER IMPORTS, 1989



Total 1989 coated paper imports: 821,456 tons.
Source: Dept. of Commerce.

TRENDS IN PAPER USE BY MAGAZINE PUBLISHERS

(000 tons)

	1989	1990e	1991e
Coated groundwood[1]	1,153	1,139	1,183
Coated free-sheet[1]	172	177	183
Uncoated groundwood[1]	221	230	242
Supercalendered[2]	30	31	31
Uncoated free-sheet[1]	17	17	17
Imported coated groundwood	59	70	77
Imported uncoated groundwood	0.7	0.9	0.6
Imported supercalendered[2]	8	10	12
Total[3]	1,660	1,674	1,746

e = Estimate.
1. North American sources.
2. Not included in uncoated groundwood category.
3. May not total due to rounding.
Source: Magazine Publishers of America, "The Paper Outlook."

U.S. COATED PAPER EXPORT/IMPORT BALANCE

(000 short tons)

Year	Exports[1]	Imports[2]
1990e	173	657
1989	169	774
1988r	97	798
1987	101	675
1986	78	501
1985	82	496
1984	86	428
1983	79	162
1982	81	69
1981	89	39
1980	92	115
1979	74	189
1978	74	214
1977	99	113[3]
1976	107	—
1975	123	—
1974	99	—
1973	80	—
1972	76	—
1971	76	—
1970	75	—
1969	70	—

e = Estimate.
r = Revised.
1. Clay-coated printing/writing paper.
2. Coated and impregnated printing papers.
3. In previous years, coated paper imports were reported under another category.
Source: Bureau of the Census.

TRENDS IN MAGAZINE-GRADE PAPER BASIS WEIGHTS

(% of total usage)

Basis weight	1988	1989e	1990e
32 lb and below	3.3%	3.5%	3.9%
33 lb	0.1	0.1	0.1
34 lb	33.3	33.7	35.4
35 lb	0.2	0.2	0.2
36 lb	11.9	11.2	10.0
38 lb	5.7	5.3	5.2
40 lb	22.5	21.1	20.6
45 lb	3.6	6.3	6.2
50 lb	8.9	8.3	8.2
55 lb	0.4	0.4	0.4
60 lb and above	10.1	9.9	9.8

e = Estimate.
Source: Magazine Publishers of America, "The Paper Outlook."

Paper:

UNCOATED FREE-SHEET

Uncoated free-sheet papers represent the largest of the three printing/writing grades (the others being uncoated groundwood and coated papers) and have a vast array of end uses. Among these are personal and business stationery and envelopes, carbonless basestock for business forms, book paper, reprographic and other business papers, basestock for thermal paper, and commercial printing, mostly for direct mail not otherwise classified in the stationery or envelope categories.

Uncoated papers are made mostly from chemical pulps (sulfate, sulfite, soda, cotton linters, or vegetable fiber), except for cotton-content paper, which is related to uncoated free-sheet and discussed in a separate chapter. Few uncoated free-sheet mills add any mechanical pulp to the fiber mix (to be called free-sheet it must contain less than 10% mechanical), but mills are introducing furnishes such as chemi-thermomechanical pulps (CTMP) and recycled fibers, which can be combined with kraft pulp to reduce the cost of manufacture while providing a better grade of paper than stone groundwood or other mechanical pulps.

Four subgroupings are based on end use: publishing, commercial printing, office/business, and writing. A smaller subgrouping includes products such as cigarette papers and carbonizing tissue.

Both offset and copy papers each represent about one-quarter of uncoated free-sheet production in the U.S., with offset dropping slightly as reprographic paper is used more and more in such applications as computer page (laser) printers, copiers, and other office technologies. Forms bond represents almost 20% of 1989 production, while envelope was just under 11%. Tablet dropped from about 4% to just over 3%, and text and cover grades about 3.7%, with the balance composed of miscellaneous printing/writing papers.

U.S. STATISTICS FOR UNCOATED PRINTING/WRITING PAPERS*

	1990e	1989	1988	1987	1986	1985
Production,[1] 000 tons	11,595	11,043	11,277	10,977	10,410	9,750
Capacity, 000 tons	12,403	12,149	11,853	11,493	11,023	10,515
Utilization rate	93.5%	90.9%	95.1%	95.5%	94.4%	92.7%
Imports, 000 tons	580	586	592	417	454	365
Exports, 000 tons	118	100	83	68	50	65
Apparent U.S. consumption						
000 tons	12,057	11,529	11,786	11,326	10,814	10,050
lb/capita[2]	96.30	92.52	95.54	93.19	89.80	84.23
000 tons/billion $ real GNP (1982)	2.86	2.78	2.93	2.94	2.91	2.78

* = All tons are short tons.
e = Estimate.
1. American Paper Institute data for shipments.
2. Revised.
Source: *Pulp & Paper.*

U.S. production of uncoated free-sheet is concentrated primarily in the Northeast and upper Midwest, although capacity in the South has grown strongly during the last 20 years. Capacity has also increased in Canada, where four new uncoated free-sheet machines have come online since 1987.

Forecasts by the American Paper Institute indicate that capacity of uncoated free-sheet paper (including cotton and thin) is expected to grow regionally in the 1988-92 period as follows: New England, 1.9%; Mid-Atlantic, 2.4%; east North Central (Midwest), 4.2%; South Atlantic, 26.5%; east South Central, 3.2%; west South Central, 39.9%; and Mountain and Pacific, 3.9%. A small amount of tonnage is also produced in seven states bounded on the north by North Dakota and Minnesota and on the south by Kansas and Missouri. In 1992, the Midwest (east North Central) and South Atlantic regions each will account for about 18% of capacity. The New England and Mid-Atlantic states combined will represent about 23% of capacity.

New capacity onstream by the end of 1991 will include Georgia-Pacific Corp., 290,000-tpy machine at Port Hudson, La. (1988); Champion International Corp., 260,000-tpy (1987) and 115,000-tpy (1989) conversions from unbleached kraft paper at Pensacola, Fla.; Domtar Inc., two 160,000-tpy machines at Windsor, Que. (1987 and 1989); Weyerhaeuser Canada Ltd., 217,000-tpy machine at Prince Albert, Sask. (1988); Canadian Pacific Forest Products Ltd., 175,000-tpy machine at Dryden, Ont. (1989); Boise Cascade Corp., 300,000-tpy machine at International Falls, Minn. (late 1990 or 1991); Willamette Industries Inc., 255,000-tpy machine at Bennettsville, S.C. (September 1990); G-P, 325,000-tpy machine at Ashdown, Ark.; and Union Camp Corp., 240,000-tpy machine at Eastover, S.C. (1991). Federal Paper Board is considering its first uncoated free-sheet printing/writing paper machine for Augusta, Ga., rather than a previously planned bleached paperboard machine. The two grades are similar, and Federal already makes bristol papers sold in the printing/writing markets.

U.S. mills are building larger machines, such as the massive units being installed by Boise Cascade at International Falls and G-P at Ashdown. The number of machines producing over 125,000 tpy rose from 7.5% of total industry capacity in 1975 to 34% in 1987. Units of 75,000 tpy and below fell from 72.5% of industry capacity in 1975 to 43% in 1987.

UNCOATED FREE-SHEET PAPERS CLASSIFIED BY END USE

- Printing/publication
  - Offset (book)[1]
  - Lightweight printing[1]
  - Envelope[1]
  - Tablet[1]
  - Cover and text[1]
- Writing
  - Bond
  - Cotton fiber[2]
- Bristols[2]
- Business
  - Forms bond[1]
  - Copy and reprographic[1]
  - Carbonless[1]
  - Mimeograph[1]
  - Duplicating[1]
  - Other
- Thin papers
  - Carbonizing
  - Cigarette
  - Condenser

1. Conforms to American Paper Institute classification of free-sheet.
2. This grade discussed in separate section.

Mill integration is another continuing trend as producers add onsite pulp capacity instead of buying market pulp. Many mills are building pulp facilities with enough capacity to supply more than the current requirements. In 1989, about 78% of all U.S. paper mills were integrated—up from 64.8% in 1976, according to API data.

Both integrated and nonintegrated mills are relying more and more on outside sources for deinked pulp and pulp substitutes (white shavings, etc.) as demand for recycled papers grows, spurred in part, at least, by legislation or threatened legislation and demands by the U.S. Government Printing Office and Environmental Protection Agency. Some new deinking plants are being built, but currently fewer than ten regularly supply fiber for printing/writing papers.

For the nonintegrated mills, the price of pulp (literally, the price of being nonintegrated) can have a dramatic effect on these mills. The cost of pulp represented only 33.9% of selling price in 1970, whereas in 1980 it rose to 56.0% in the U.S. The situation improved in early 1982, when hard-

U.S. PRODUCTION AND CAPACITY OF UNCOATED FREE-SHEET PAPERS*

(000 short tons)

Year	Production[1]	Change (%)	Capacity[2]	Change (%)
1991e	n.a.	n.a.	13,180	6.3
1990e	11,595	5.0%	12,403	2.1%
1989	11,043	2.1	12,149	2.5
1988	11,277	2.7	11,853	3.1
1987	10,977	5.4	11,493	4.3
1986	10,410	7.4	11,023	4.8
1985	9,690	5.9	10,515	4.5
1984	9,152	4.9	10,058	7.5
1983	8,725	11.7	9,354	3.5
1982	7,809	-0.1	9,039	2.4
1981	7,867	-0.1	8,828	2.1
1980	7,984	4.6	8,645	6.8
1979	7,655	6.3	8,095	3.1
1978	7,198	2.3	7,847	5.1
1977	7,036	9.4	7,465	2.0
1976	6,430	13.9	7,319	1.9
1975	5,644	-18.6	7,180	1.9
1974	6,934	0.0	7,046	7.7
1973	6,933	9.4	6,541	5.5
1972	6,339	18.5	6,198	7.2
1971	5,349	3.3	5,780	1.3
1970	5,177	-0.8	5,702	0.3
1969	5,222	—	5,681	—
Average 1970-90		4.4		3.8

*Excluding cotton fiber, bristol, and thin paper.
e = Estimate.
n.a. = Not available.
1. Source: Bureau of the Census.
2. Source: American Paper Institute.

wood pulp was available at deep discounts and the list price for pulp was unchanged from 18 months earlier. Pulp represented only 49.7% of the paper grade's selling price, assuming no pulp discount. The percentage was lower if discounts were applied. The pulp cost advantage of an integrated mill—$100 in 1980—probably declined as the pulp market slid. In mid-1984, pulp prices began rising again, and uncoated free-sheet was plagued by continued discounting, especially in offset grades. The cost of pulp climbed back up to 53.5% of the paper grade's selling price. The ratio of selling prices dropped back down in 1985, but it began another climb following strong pulp price increases in late 1986, 1987, 1988, and early 1989.

CAPACITIES OF NORTH AMERICAN UNCOATED FREE-SHEET PRODUCERS (1990)

		Annual capacity (000 short tpy)	Market share (%)
1.	International Paper	2,100	14.9%
2.	Georgia-Pacific/GNN	1,970	14.0
3.	Champion International[1]	1,114	7.9
4.	Boise Cascade	910	6.5
5.	James River	872	6.2
6.	Weyerhaeuser[2]	807	5.7
7.	Union Camp	800	5.7
8.	Mead[3]	520	3.7
9.	Simpson Paper	450e	3.2
10.	P.H. Glatfelter	420	3.0

Market share of top five companies: 49.5%
Market share of top ten companies: 70.8%
Total North American capacity/year (1990)[4]:
14,075 million short tons
U.S.: 12.403 million short tons
Canada (est.): 1.672 million short tons

e = *Pulp & Paper* estimate.
1. 1988 production.
2. Includes Prince Albert, Sask.
3. Includes carbonless basestock.
4. Includes all other companies.

ESTIMATED ANNUAL CAPACITIES OF CANADIAN UNCOATED FREE-SHEET PRODUCERS (1990)

(000 metric tons)

Domtar	318
Weyerhaeuser Canada	172
Rolland Inc.	165
Eddy Paper Co.	160
Canadian Pacific Forest Products	159
Island Paper Mills[1]	105
Fraser Inc.[2]	80

1. Owned 50% by MacMillan Bloedel and 50% by Fraser.
2. Owned by Noranda Forest Inc.
Sources: *Pulp & Paper estimates*, company data.

In addition, nonintegrated mills tend to have higher fuel costs because they do not generate wastewood to supply biomass boilers, nor do they produce byproduct fuel from kraft liquor. Their biggest advantage is lower transportation costs because of their proximity to major markets in the North.

Commodity-grade mills (offset paper, forms bond, and reprographic paper) use twin-wire or large fourdrinier paper machines. Southern mills use a blend of hardwood and softwood pulps. Hardwood fibers provide desired bulk and printing characteristics, and softwood fibers offer strength properties for improved paper machine and printing press runability.

The 1980s showed strong growth for uncoated free-sheet papers. Shipments leaped 11.7% in 1983, after 0.1% drops in both 1982 and 1981, according to API figures. Shipments rose 4.9% in 1984, 5.9% in 1985, 7.4% in 1986, 5.5% in 1987, and 3.2% in 1988. They had a slight 2,1% decline in 1989, however, due in part to high customer inventories and other factors.

Operating rates have remained fairly strong despite some slackening in 1989. Although, by mid-1990, rebuilding of customer inventories and generally strong demand was boosting shipments above year-earlier levels. A recession in 1991 or 1992, along with the addition of almost 1 million tons of capacity in 1990-91, could dampen operating rates to below 90%, but the industry as a whole will stay well above that level. A number of mills took extended maintenance downtime in 1990 because of slower demand and higher pulp prices.

In the early 1980s, mills operated at rates below 90%. In 1981, the operating rate for uncoated free-sheet mills was 89.1%, which fell to 86.4% in 1982. The market began to strengthen, and operating rates rose to 93.3% in 1983, 91.0% in 1984, 92.2% in 1985, 94.4% in 1986, 95% in both 1987 and 1988, and 91% in 1989. Utilization rates were

RISE OF ROLLSTOCK vs SHEET-FED PAPER IN U.S. UNCOATED OFFSET FREE-SHEET PAPER INDUSTRY

(% of total uncoated free-sheet shipments)

Year	Rolls	Sheets
1995	74%	26%
1990	70	30
1988	68	32
1984	66	34
1980	61	39
1975	53	47
1970	45	55
1965	35	65

Source: *Pulp & Paper* estimates.

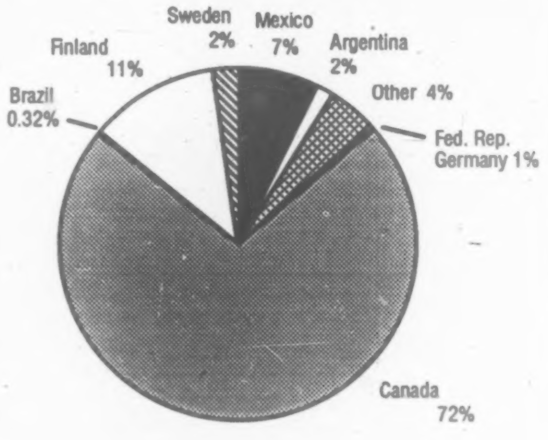
forecast to run about 93% in 1990.

Uncoated free-sheet (or white papers) has "been a tremendous growth market in the past and shows continuing promise for the future," according to John D. Maine, vice president-printing and writing papers at Resource Information Systems Inc. Maine, speaking at the White Papers & Office Automation Conference in 1989, said that since 1982, U.S. uncoated free-sheet demand has increased a phenomenal 7%/year. He expects a mild recession, based on GNP growth of only 2.5% in 1989 and a decline of 0.1% in 1990, to dampen demand slightly. This still compares favorably with the 2.5% drop in GNP during the 1982 recession. Maine's outlook for 1991 to 1993 is more optimistic—3% to 4%/year growth.

Advances in electronic imaging machines for business use probably will continue to benefit some grades of form bond and cut-size papers used in office copiers and computer printers. "Information processing is a part of life—our society has evolved to a point where the only possible direction is toward more and better and faster information processing," said Dana G. Mead, executive vice president of International Paper Co., at the White Papers Conference. Longer-term, Mead wondered whether or not the technologies driving growth in paper consumption are subject to change like other technologies. "Information on paper isn't information until it's read. I think information that doesn't need to be read—it only needs to be stored, for example—will be increasingly independent of paper," Mead said.

Yet, in the shorter-term, Mead thinks paper consumption will continue to rise. "Our industry's best candidate for the title 'Raw Material of the Information Age' is uncoated free-sheet. We see operating rates in the nineties into the 1990s . . . unprecedented demand for computer paper and copier paper has kept supplies tight."

U.S. UNCOATED FREE-SHEET IMPORTS, 1989



Total uncoated free-sheet imports: 586,090 tons.
Source: Dept. of Commerce.

Mead also said that "information workers" use a lot of paper. "According to some estimates I've seen, every white-collar worker used 18,000 sheets of paper [in 1988], will use 22,000 [in 1989], 26,000 [in 1990], and so on until . . . who knows how long this will go on?"

But Mead also pointed to some potential problems facing the white papers industry, including world literacy and environmental barriers. The greatest potential opportunity for growth is in countries where illiteracy is highest. In addition, Mead said, paper manufacturers face concerns about pollution abatement, waste disposal, dioxins, product contamination, and employee health.

Paper prices were strong beginning in late 1986, but in 1989, new capacity and work-off of customer inventories brought favorable discounts to buyers. In 1989 and early 1990, discounts on offset grades were as high as $60 to over $100/ton, while prices for cut-size copy papers were off the same. Also affecting pricing was relatively cheap and readily available paper from offshore. Increases in uncoated free-sheet capacity (2.8% in 1989, 3.5% in 1990, and 3.7% in 1991), ". . . will hit at a time of slower economic advances," API said. Canada's trade agreement with the U.S. eliminates cross-border tariffs on business forms in 20% increments over a five-year period that began on Jan. 1, 1989.

U.S. imports of uncoated free-sheet jumped almost 37%

FIBER COSTS FOR PRODUCING PRINTING GRADES AT NONINTEGRATED PAPER MILLS

Year	45-lb No. 3 offset sheets ($/short ton)	Northern hardwood kraft market pulp ($/short ton)	Ratio of selling prices (pulp/paper)
1989	$940	$745	0.793
1988	1,020	705	0.691
1987	850	522	0.614
1986	850	426	0.501
1985	800	327	0.409
1984	880	426	0.484
1983	840	381	0.454
1982	680	345	0.507
1981	878	445	0.507
1980	813	445	0.547
1979	717	393	0.548
1978	645	310	0.481
1977	555	250	0.450
1976	506	300	0.593
1975	484	335	0.692
1974	535	335	0.626
1973	457	225	0.492
1972	460	135	0.293
1971	455	135	0.297
1970	442	155	0.351

Note: All prices are year-end.
Source: *Pulp & Paper Week*, *Pulp & Paper Pricebook 2.*

from 433,000 tons in 1987 to almost 595,000 tons in 1988 but fell slightly in 1989, according to Dept. of Commerce figures. Canada was the major source, shipping over 425,000 short tons of uncoated free-sheet papers to the U.S. in 1989, an increase of 63% from 1988, according to the Canadian Pulp & Paper Assn. Scandinavian countries followed with more than 84,000 tons (not including Norway). Brazil lost market share because of 100% duties on certain Brazilian paper products imposed as retaliation for unrelated trade violations. Brazil shipped only 1,850 tons of paper to the U.S. in 1989, a decline of almost 98%. Those sanctions were removed in 1990. Mexico shipped almost 44,000 tons, a 41% drop from the previous year.

ALKALINE PAPERS

A number of mills have converted some or all of their machines to alkaline-based paper, and many new installations are based on the alkaline process. The following are some of the conversions already implemented or planned: all of International Paper's uncoated free-sheet mills, Weyerhaeuser Canada in Saskatchewan, Domtar's two machines in Quebec, and Willamette's machine in South Carolina.

The alkaline process helps control costs for fiber and fillers, such as titanium dioxide TiO_2 and calcine clay. Alkaline sheets are also stronger than acid-based papers, and the use of precipitated calcium carbonate (PCC) helps cut down fiber use.

Among the selling points to some buyers, especially librarians and businesses concerned with archival-quality documents, is the permanence of alkaline papers compared with acid-based stocks. The American Library Assn. Council and the National Information Standards Organization are urging publishers to print books with alkaline-based papers. Both groups worry about deterioration of library collections, according to a published report.

Pfizer Inc. is responsible for building, operating, and owning onsite satellite plants that produce PCC. D.R. "Randy" Harrison, manager of market development at Pfizer, told delegates to ***Pulp & Paper*'s** first White Papers Conference that alkaline paper represented 22% of uncoated free-sheet capacity in 1988. He said he expected the figure to rise to 66% of installed capacity by 1990. Some 50 mills have already converted or are in the process of converting, according to William C. Sellers, manager of business planning for Hammermill Papers, who also spoke at the conference.

Sellers said that alkaline paper offers excellent optical and physical properties, higher natural brightness, permanence, bulk improvement, greater stiffness and overall strength, and better printability—for lower processing costs. He added that alkaline paper can be recycled within the mill operation without significant loss of strength.

RECYCLED PAPERS

Mills, merchants, and customers are realizing more and more that recycling is an issue that will not go away. The paper industry is facing tough mandatory recycling legislation as well as customers who are increasing their requests for access to quality recycled papers, particularly in the printing and writing grades.

"Merchants know that there's a demand out there on the part of customers for more recycled products," said John J. Buckley Jr., president of the National Paper Trade Assn. (NPTA). "This is no longer an issue of just the maniacs and the radicals—it's becoming more and more of an issue for mainline customers," such as printers, Buckley said.

NEW U.S. AND CANADIAN UNCOATED FREE-SHEET CAPACITY THROUGH 1992

Company, U.S.	Location	Annual capacity (short tons)	Year
International Paper	Various	200,000	1988-90
Champion International	Courtland, Ala.	40,000	1989
Hammermill	Selma, Ala.	35,000	1989
Kimberly-Clark	Whiting, Wis.	30,000	1989
Champion International	Pensacola, Fla.	120,000	1989
Willamette	Bennettsville, S.C.	255,000	1990
Champion International[1]	Quinnesec, Mich.	(net) 58,000	1990-91
Georgia-Pacific/Nekoosa	Ashdown, Ark.	80,000	1990
Union Camp	Eastover, S.C.	50,000	1990
Boise Cascade	International Falls, Minn.	308,000	1990
Georgia-Pacific/Nekoosa	Ashdown, Ark.	325,000	1991
Union Camp	Eastover, S.C.	240,000	1991
Weyerhaeuser[2]	Columbus, Miss.	200,000	1992
Bowater[2]	Calhoun, Tenn.	340,000	1992
Champion International[2]	Courtland, Ala.	140,000	1992
Federal Paperboard	Augusta, Ga.	300,000	Under study
Company, Canada	**Location**	**(metric tons)**	**Year**
Weyerhaeuser Canada	Prince Albert, Sask.	217,000	1988
Domtar	Windsor, Que.	160,000	1989
Canadian Pacific Forest Products	Dryden, Ont.	175,000	1989

North American capacities, 1990
U.S.: 12.403 million short tpy
Canada: 1.517 million metric tpy

1. Initially will produce uncoated free-sheet, but designed for coated.
2. Machine announced or discussed in principle, but plans not finalized.

Sources: *Pulp & Paper Week* estimates, American Paper Institute, Canadian Pulp & Paper Assn.

"Merchants are finding the biggest demand for recycled printing and writing papers right now is in big business [and] the government contract business," he added.

What is leading this realization is the very visible problem of what to do with solid waste, about 41% of which is composed of paper and paperboard, according to the National Solid Waste Management Assn. That's about 65 million tons of garbage in 1986 alone.

"The issue of disposal of solid waste is at an absolute critical point. The paper industry is going to have to address that," said Jobe B. Morrison, president of Miami Paper Corp., a unit of Cross Pointe Paper Corp., a Pentair Inc. company. Cross Pointe sells a variety of recycled papers from its Miami mill in West Carrollton, Ohio, and Flambeau Paper in Park Falls, Wis.

Industry participants and observers suggest that correlative issues include dioxins resulting from bleaching of recycled fiber. There are bleaching processes that do not use elemental chlorine, which creates dioxins as a byproduct. Europeans have accepted paper that is less bright, or even off-color, but many in North America seem to the think consumers are not yet ready to give up those attributes.

These recycled grades—as opposed to those using clean, preconsumer or precommercial waste—are not like what many customers are used to seeing, explained Bill Litviak, a sales representative for Wilcox, Walter, Furlong Paper Co. WWF Paper represents Cross Pointe, Glatfelter, and French Paper Co.

Shelley Hamel, marketing coordinator at Earth Care Paper Co., a mail-order retailer of recycled paper products, thinks the public is indeed ready for such paper. In fact, she said, the company's most popular business paper is called Minimum Impact, an unbleached, 100% recycled paper from P.H. Glatfelter Co. Minimum Impact has "kind of" a beige color.

The biggest problem, Hamel said, is the price differential between recycled fiber paper and virgin fiber paper. Currently, recycled grades generally cost up to 10% more than their virgin fiber counterparts. It has been made worse recently by the strong discounts in virgin fiber uncoated free-sheet papers at the same time as demand for recycled papers has increased.

NPTA's Buckley agrees but believes there is a gap between what customers say they want and what they are actually willing to pay for. "There is a strong feeling out there that no one is willing to pay more to get a recycled fiber (paper)." They may say they are willing to accept slightly lower quality and performance, but when it comes to spending more for it, they back off and go for the virgin fiber, Buckley said.

Still, Hamel reported that her company is experiencing rapid growth. "Customers want to buy recycled paper," she said. Earth Care sells copy and forms papers, stationery, note cards, and other products directly to consumers, retail stores, and other customers.

Litviak said that some customers, particularly printers, had bad experiences with 100% recycled paper pushed in the 1970s. Those papers had problems with stability and runability. Now, however, improved quality has pushed demand for recycled printing and writing papers beyond the fad stage.

Currently, more than 30 mills in North America produce at least a small amount of printing/writing paper they classify as recycled (see table). However, many of these are primarily preconsumer or precommercial waste, which means they are envelope clippings and other high-grade, clean white pulp substitutes.

Mills such as Hammermill Paper and Westvaco Corp. have recycled grades with at least 50% wastepaper. Hammermill includes about 10% postconsumer waste fiber in its copy paper, and Nekoosa Papers Inc. introduced a lower-brightness copy paper made with some deinked fiber.

Merchants get involved. Buckley says that the solid waste problem contains essentially three issues: stemming the reduction of resources, incineration/energy generation, and recycling.

BASIS WEIGHT AND BULK OF LWP PAPERS

Basis weight (lb, 25 x 38 in., 500 sheets)	Typical bulk (sheet/in.)
19* (28 g/m^2)	1,360
20* (30 g/m^2)	1,290
22* (33 g/m^2)	1,180
24* (36 g/m^2)	1,080
26 (38 g/m^2)	900/940
28 (41 g/m^2)	870/900
30 (44 g/m^2)	810/850
33 (49 g/m^2)	740/790
35 (52 g/m^2)	690/700
40 (59 g/m^2)	610/640

* Bible grades.

TYPICAL GRADE STRUCTURE FOR 100% FREE-SHEET OFFSET PAPERS

Basis weight (lb, 25 x 38 in., 500 sheets)	Grammage (g/m^2)	Opacity[1] (%)
35	52	82%
40	59	86
45	67	87
50	74	89
55	81	91
60	89	90
70	104	92
80	118	94

1. Government specifications for offset book printing paper; however, these are similar to those used by most companies for high-quality offset with brightness of 80 to 85.

U.S. PRODUCTION OF UNCOATED COVER AND TEXT PAPERS

(000 short tons)

Year	Cover	Change (%)	Text	Change (%)
1989	170	57.4%	224	13.7%
1988	108	-1.8	197	1.0
1987	110	8.3	195	8.3
1986	96	14.6	180	5.9
1985	87	3.3	170	2.9
1984	90	5.9	175	9.4
1983	85	13.3	160	18.5
1982	75	—	135	6.9
1981	75	1.3	145	10.5
1980	76	5.0	162	0.5
1979	80	8.1	163	18.1
1978	74	8.8	138	13.1
1977	68	19.3	122	2.5
1976	57	32.6	119	5.3
1975	43	17.3	113	29.8
1974	52	5.5	161	2.4
1973	55	12.2	165	13.0
1972	49	14.0	146	5.8
1971	43	—	138	—

Source: *Pulp & Paper* estimates.

PRODUCERS OF LWP AND THIN PAPERS

Lightweight printing

Allied Paper Inc.
Jackson, Ala.

P.H. Glatfelter Co.
Neenah, Wis.

James River Co.
Kalamazoo, Mich.

Fletcher Paper Co.
Alpena, Mich.

Fraser Paper Ltd.
Madawaska, Maine

Kimberly-Clark Corp.
Lee, Mass.[1]
Neenah, Wis.

Ecusta Corp.[2]
Pisgah Forest, N.C.

Port Huron Paper Co.
Port Huron, Mich.

Champion International Corp.
Deferiet, N.Y.

Cigarette

Kimberly-Clark Corp.
Spotswood, N.J.[1]
Ancram, N.Y.[1]

Ecusta Corp.
Pisgah Forest, N.C.

1. Schweitzer Div.
2. Div. of P.H. Glatfelter.

NPTA has formed a Solid Waste Action Network, which so far has about volunteers from member locations. When the network becomes mobilized, these and other volunteers will become educated on resource issues and will take an active interest in local issues related to recycling and waste management.

The purpose of the network is to help educate the industry at the same time as the industry helps educate the public. It is an effort to influence legislation on a local level. Many states and municipalities have already implemented or are considering strict legislation regarding recycling and content of recycled papers.

This effort is separate from the approximately $4-million program being implemented by API this year, though NPTA also works with API, Buckley said.

Among the mills that have announced entry or expansion in the recycled printing/writing market in 1989 and 1990 were Nekoosa, Hammermill Papers, Westvaco, Noranda Forest Inc., Domtar, and Hopper Paper, an operating unit of Georgia-Pacific, which plans to make cover and text grades using 50% postconsumer waste. G-P already makes some recycled copy paper at Gilman, Vt., and Kalamazoo, Mich.

OFFSET PAPERS

Offset papers are part of the family of book papers, which can include tablet and envelope paper as well as offset. All of these grades are used for printing and graphic arts purposes, and they can be readily produced on the same machines as printing papers. Properties that distinguish one grade from the other include surface finish, opacity, brightness, and bulk.

Industry sources indicated that slightly over 2.5 million tons of uncoated offset paper were produced in 1989 (down about 8% from 1988). Shipments to book publishers of uncoated free-sheet totaled 570,000 tons, off about 10% from the year before. Uncoated free-sheet represented 60% of the 1.040 million tons of paper shipped to book publishers in 1989, about the same as the prior year. Uncoated ground-

COVER AND TEXT PAPERS: TYPICAL GRADE STRUCTURE

Text		Cover	
Basis weight (25 x 38, 500)	Grammage (g/m²)	Basis weight (20 x 26, 500)	Grammage (g/m²)
60	89	50	135
65	96	60	162
70*	104	65*	176
75	111	80*	216
80*	118	90	243
100	148	100	270

* Major weights.

wood represented nearly 10%, and coated grades represented another 30%.

As with other end uses, shipments of uncoated free-sheet paper to commercial printers dropped slightly in 1989, about 2%. Coated remained about even, and uncoated groundwood papers gained approximately 20%, not as high as previous years but still substantial.

Offset papers are sold either in rolls or in sheets (cut or folio sizes), with rolls making up somewhere close to 70% of all offset paper shipments. Paper roll diameter and width must be standardized to meet the needs of printers. For stock roll grades, typical diameters are 32 and 40 in. Standard widths are 11, 17, 22, and 35 in. Buyers usually pay a trim penalty when ordering unstocked sizes.

Offset and other uncoated book papers are designed to run on high-speed offset presses. The sheet surface is sized externally at a size press on the paper machine to prepare it for the slight wetness inherent in offset printing. A high degree of resistance to picking is also essential.

Opacity is produced by TiO_2 and other fillers. Quality and price of the sheet vary because of the wide array of furnishes, fillers, and brightnesses that are available. Opacified offset paper is often preferred because it has a slightly higher brightness and a 2% to 3% higher opacity rating than standard offset book paper. Mills typically make several grades to meet the specific requirements of printing quality and price. Typical properties for a No. 1-type offset sheet are listed in this section.

Recycled fiber or mechanical pulp in the furnish produces lower-price offset paper that retains relatively high opacity levels but with a lower brightness rating. Uncoated book papers also vary in bulk and sheet surface, with bulk influenced by changes in basis weight as well as in surface treatment. Common sheet surfaces include antique, eggshell, woven, and English.

BMDX PAPERS

Bond, mimeograph, duplicating, and xerographic (BMDX) grades are similar in sheet property and basis weight, and many mills make the same paper for more than one end use. Mills often swing among grades depending on market demand. These grades are internally and surface sized because they are also commonly used for offset printing.

They are generally made from 100% chemical pulp, with both opacity and brightness in the mid-to-high eighties. Some cotton fiber may be used in high-quality bond papers, which are discussed in the Cotton Fiber chapter.

High growth in cut-sheet paper used in computer printers will help raise demand by about 6.5% annually through 1994, according to reports by BIS CAP International. The reports say that cut-sheet demand in the U.S. will post a compound annual growth rate (CAGR) of 6%/year, while in Canada the CAGR will be 7% in the 1989-94 period.

C. Thomas Ashley, director of Hard Copy Supplies Requirement Service at BIS CAP, told delegates at a company-sponsored Hard Copy Consumables conference that total cut-sheet paper for printers, copiers, typewriters, and duplicators will rise from almost 3.2 million tons in 1989 to 4.3 million tons in 1994. About 53% of that tonnage will be used in copiers, with about 41% for computer printers. Total U.S. cut-size retail value will rise from $5.2 billion in 1989 to $7.1 billion in 1994, Ashley said.

Growth in cut-sheet paper for computer printers will advance 16%/year, and for copiers, 4%. Cut-sheet paper used

PAPER SHIPMENTS TO U.S. BOOK PUBLISHERS, 1980-89

(000 short tons)

Year	Coated two side			Uncoated free-sheet	Uncoated groundwood	Total
	Total	Nos. 1-4	No. 5			
1989	286	235	51	570	90	946
1988	320	263	70	630	82	1,032
1987	300	245	53	560	70	930
1986	298	238	60	524	68	890
1985	280	223	57	454	53	787
1984	289	219	70	482	70	841
1983	250	190	60	435	75	760
1981	250	165	85	460	105	815
1980	240	150	90	475	115	830

Source: *Pulp & Paper* estimates.

TYPICAL BULKS FOR BOOK PAPERS AT DIFFERENT BASIS WEIGHTS AND SHEET FINISHES

Basis weight (25 x 38, 500)	Standard bulks			
	Antique (ppi)*	Eggshell (ppi)*	Standard (ppi)*	English finish (ppi)*
45	—	492	540	600
50	410	440	488	540
55	360	386	444	500
60	330	364	408	440
70	288	316	350	390

* ppi = Pages (sheets) per inch.
Source: International Paper.

in typewriters and duplicators will decline substantially over the five-year period (see table).

Mark Hanley, manager of BIS CAP Europe, painted a similar picture for Canada. Demand for cut-sheet in printers will advance 16%/year to reach 149,000 tons in 1994. Copier cut-size use will advance at a CAGR of 6% to reach 169,000 tons. Again, Hanley said that cut-sheet use for both typewriters and duplicators will decline about 12%/year.

Hanley put the value of the cut-size market at $397 million in 1989, rising to $557 million in 1994.

In the forms area, Ashley said single-sheet stock continuous forms paper will rise about 3%/year in the U.S., but multipart forms will fall about 5% annually. Stock continuous represented about 1.6 million tons in 1989, rising to 1.7 million tons in 1994. Custom continuous forms also will post slower growth rates than in the recent past in concert with its general decline compared with stock forms. Custom single-part tonnage will rise just 2%/year, and multipart will fall 3%/year. Total custom forms tonnage will drop about 50,000 tons from 1989 to 1994, Ashley said.

The Canadian continuous forms picture is similar, according to Hanley. Single-part stock continuous will advance about 4% annually, but multipart continuous will slide 4%/year. For custom continuous forms paper, single-part forms will stay essentially even, at 55,000 tons in 1994, while multipart forms will dip 4%/year. Total forms tonnage in Canada will rise to about 240,000 tons by 1994, only 2,000 tons higher than 1989, Hanley said.

Thermal and other specialty papers related to electronic data transmission and printouts, made with a base of uncoated free-sheet paper, will perform much better than both cut-sheet and forms markets, according to BIS CAP. For instance, demand for thermal paper in the U.S. will rise from almost 33,000 tons in 1984 to 107,000 tons in 1994—a 27% CAGR. Canadian thermal paper demand will advance 18%/year, rising to just under 8,000 tons in 1994.

Electrostatic paper will also advance rapidly, though not nearly as much as thermal paper, according to BIS CAP estimates. CAGR for electrostatic paper from 1989-94 will be 11% for both the U.S. and Canada. U.S. demand is pegged at 40,000 tons and Canadian at 3,000 tons in 1994.

FORMS BOND

Forms bond is less expensive than copy paper, though it is made on the same paper machines. It is used on high-speed, continuous data processing equipment that employs direct-impact printing methods. Desired qualities include stiffness and strength for fast feeding and printing and for refolding without distortion, lint-free printing surface, proper dimensional stability for perfect register, and a high degree of paper cleanliness.

Forms bond competes directly with uncoated groundwood grades that are substantially less expensive. Top-quality forms bond is produced from 100% chemical pulp fiber, often made by blending softwood and hardwood kraft pulps. Forms paper also may have some secondary (recycled) fibers, groundwood pulp, or bleached chemi-thermomechanical pulp to reduce both production cost and sales price. The price for blended (free-sheet/groundwood) forms sheets can be 25% below free-sheet bond in a normal market. Forms paper made substantially of groundwood pulp are priced at around 50% below free-sheet. Groundwood forms paper may not always be surface-sized, thus reducing printing press runability and printability. Groundwood paper also has lower brightness and opacity than the free-sheet product.

Among the leading producers of free-sheet forms bond are Georgia-Pacific (including Great Northern Nekoosa), Boise Cascade, International Paper, Mead Corp., and Union Camp. G-P also makes blended bonds, and Abitibi-Price Inc. is strongest in groundwood forms paper.

Forms bond accounted for about 20% of all uncoated free-sheet shipments in 1989. Of shipments to forms converters, free-sheet represented 93% of the total. The remaining 170,000 tons consisted of groundwood and coated papers. Groundwood shipments to forms converters have been declining as a percentage of the total forms market for several years, but coated have been increasing and account for over 20,000 tons.

COMMON BASIS WEIGHTS FOR BMDX GRADES

Basis weight (17 x 22, 500)	Grammage (g/m^2)	Bond	Mimeograph	Duplicating	Copy
13	49	X			
16	60	X	X	X	
18	68	X	X	X	
20	75	X	X	X	X
24	90	X*	X		X
28	105	X*			
32	120	X*			
36	135	X*			

* Ledger grades.

CARBONLESS PAPER

Carbonless paper, again made with a base of uncoated free-sheet paper, has been one of the fastest-growing segments of the paper industry for nearly two decades and accounts for about 700,000 tons of uncoated free-sheet production. Meanwhile, one-time carbonizing paper is still losing ground to carbonless in end uses such as business forms, order books, and charge-card receipts, with production dropping nearly 13% in 1989 from the previous year.

Carbonless paper uses a top or "donor" sheet to transfer the image to succeeding sheets with the aid of an encapsulated dye coated onto the back side of the paper. When the top surface is imprinted, the pressure breaks the dye on the back, and the image is transferred to the top of the next sheet. The receiving side is coated with kaolin clay in order to enhance the sharpness of the received image. This system makes up to five replicas.

A carbonless forms unit generally has a basestock (cb) made from high-quality chemical pulps on a standard fourdrinier paper machine. The receiving sheet is coated on the paper machine, and the stock then goes to an off-machine coater for the encapsulated dye. When more than two sheets are desired for a set of forms, the intermediate sheets

U.S. PRICES FOR UNCOATED WHITE PAPER

($/short ton)

Year	Offset 50-lb rolls	Bookpaper No. 3 offset +45-lb sheets	Bond, No. 4 unwatermarked 20 to 24-lb sheets	No. 1 watermarked +20-lb sheets	Forms bond 15-lb rolls	Bond 25% cotton sheets	Carbonless coated-back 15-lb rolls
1990							
2Q	$810	$940	$980	$1,095	$840	$2,200	$1,960
1Q	810	940	975	1,095	830	2,200	1,960
1989							
4Q	790	940	975	1,095	830	2,200	1,920
3Q	810	940	980	1,095	840	2,200	1,920
2Q	900	1,020	1,020-1,040	1,090-1,100	(880)	2,200	1,960
1Q	900	1,020	1,040	1,090-1,100	(880)	2,200	1,960
1988							
4Q	880-900	1,020	960	1,090	910	2,200	1,960
3Q	840-850	960	920	1,080	850/870	2,200	1,904
2Q	810	920	880	1,070	850/870	2,125	1,904
1Q	770	870	840	1,030	800	2,125	1,778
1987							
4Q	750	850	820	980	760	1,990/2,060	1,778
3Q	750	820	727-747	(920)/985	760	1,900	(1,660)
2Q	(640)	820	760	(930)/985	720*	1,810	(1,625)
1Q	(640)	820	(720)/820	(930)/985	720*	1,810	(1,625)
1986							
4Q	700	850	820*	985*	720	1,810	1,710
3Q	706	850	807	985	687	1,810	1,710
2Q	(663)	(840)	(760)	985	(660)	1,810	1,593
1Q	(597)	(800)	(760)	985	(620)	1,810	1,458
Year end							
1985	(567)	(800)	(760)	985	(600)	1,810	1,355
1984	(600)	(880)	(773)	985	(693)	1,810	1,355
1983	690	840	810	960	745	1,650/1,730	n.a.
1982	(540)	680	640	916	640	1,650	n.a.
1981	690	878	867	916	753	1,650	n.a.
1980	n.a.	813	803	848	697	1,490	n.a.
1979	n.a.	711/717	720	778	620	1,309/1,343	n.a.
1978	n.a.	645	640/644	695	538/550	1,190/1,230	n.a.
1977	n.a.	548/555	548/590	645/650	450/500	1,143	n.a.
1976	n.a.	506	561	628	519/520	1,083	n.a.
1975	n.a.	484	550	605	495/504	1,012	n.a.
1974	n.a.	535	559	637	470	984	n.a.
1973	n.a.	457	495	n.a.	n.a.	734	n.a.
1972	n.a.	460	470	n.a.	n.a.	728	n.a.
1971	n.a.	455	460	n.a.	n.a.	719	n.a.
1970	n.a.	442	445	n.a.	n.a.	n.a.	n.a.

*Discounting from list prices reported.
( ) = Indicates estimated transaction prices where most volume is moving significantly below list.
n.a. = Not available.
Sources: *Pulp & Paper Pricebook; Pulp & Paper Week.*

(cfb) are coated on the front with kaolin and on the back with dye. The last sheet (cf) is coated on the front, but not on the back, with a top coating to receive the image.

James W. Gibson, industry manager, carbonless and forms grades at Mead's Fine Paper Div., said multipart business forms, which use carbonless paper, grew substantially during the 1970s and 1980s. Gibson told delegates to the White Papers Conference in 1989 that forms paper shipments rose from about 1.1 million tons in 1971 to almost 3.5 million tons in 1988, though other sources put forms paper shipments at an even 3 million tons for both 1988 and 1989.

Gibson also said that "since 1971, the use of carbonless paper in the United States has grown at a CAGR of 12%." That growth is a result of several factors, including general economic growth and the proliferation of computers and computer printers.

Carbonless has grown faster than other forms grades, and its growth has come at the expense of carbonizing tissue. Gibson said that in 1971, about 80% of multipart forms in the U.S. used interleaved carbon paper and 10% used carbonless. The remainder used carbon applied directly on the back of carbonizing bond. By 1987, those figures had changed substantially, with 40% of multipart forms using carbon and 50% using carbonless.

CARBONIZING BASESTOCK AND CARBONIZING TISSUE PRODUCTION

(000 short tons)

Year	Carbonizing	Carbonless
1989	83	700
1988	97	689
1987	109	600
1986	117	539
1985	125	498
1984	141	443
1983	150	390
1982	180	370
1981	180	320
1980	181	295

Source: *Pulp & Paper* estimates.

FORMS BOND: TYPICAL GRADE STRUCTURE

Basis weight (17 x 22, 500)	Grammage (g/m^2)
9	34
10	38
12	45
15	56
16	60
18	68
20	75
24*	90
28*	105
32*	120

* Ledger/tag weights.

The outlook for carbonless depends on these factors: the acceptance of electronic data interchange as a substitute for forms use, the growth rate of nonimpact printers, and the elimination of carbon paper. Gibson expects carbonless to continue growing until it accounts for 80% or more of the multipart forms market—perhaps a growth rate of 4% to 6%/year through 1993. Ralph L. Waehner, president of Moore Business Forms & Systems Ltd.-Canada, told delegates at the conference that shipments of carbonless paper may grow nearly 9%/year through 1993. His company estimated North American production of carbonless basestock at 920,000 tons in 1988. Industry sources indicate that U.S. shipments of carbonless basestock in 1988 amounted to nearly 690,000 tons.

Appleton Papers Inc. is the leading producer of carbonless basestock and a major converter as well. The company applies the dye on off-machine coaters and then rolls the paper into sets. Other major converters include 3M Co., Moore Business Forms (about 240,000 to 250,000 tpy), Standard Register Co., and Nashua Corp. Mead also is a force in the market, producing about 150,000 tpy of basestock. It developed a process called "opas" that allows production of carbonless forms at printing plants through modification of existing offset presses, thus enabling printers to expand their use of carbonless paper.

Moore Business Forms is shifting from blue-image to black-image carbonless. Other large producers and converters, such as Standard Register, are also changing some of their production from blue-image paper.

LIGHTWEIGHT PRINTING GRADES

Lightweight printing (LWP) grades generally have a basis weight around 40 lb (25 x 38 in., 500 sheets), and they are used for products ranging from Bibles to business forms. At least for forms bond, the very lightest basis weights are no longer favored, as multipart business forms give way to single-part forms requiring stronger surfaces. In this area, the trend is toward basis weights between 18 and 20 lb, although 15 lb is still the most common.

In LWP grades, opacity should be about 85% when the paper has more than a 26-lb basis weight. Heavy use of fillers helps accomplish this goal. Even lighter papers, ranging from 19 to 24 lb with opacities of 80% to 85%, are used for Bibles. Lightweight grades are also used when page weight and bulk must be reduced in books and catalogs.

Various fibers are used to make LWP grades, including chemical pulps, cotton fiber, flax straw, or combinations thereof. Production data for these grades, except cotton, are not available.

COVER AND TEXT PAPERS

Cover and text papers have heavier basis weights than standard offset papers. They are used as covers for magazines, pamphlets, and paperback books, as well as for text pages in these publications. Cover and text papers can be as heavyweight as bristols, and they are sold in both coated and uncoated grades. Coverstock can be embossed, coated, plastic-coated, or laminated with cloth.

Cover and text papers provide better quality for a higher price than offset paper. They are made in a variety of colors and finishes, and they are manufactured by the same companies that make offset and bond papers. Bleached board producers such as Federal Paper Board Co. Inc. and Temple-Eastex Inc. also make coverstock, especially coated cover.

Demand for these grades has grown about 4.8%/year since 1979, reaching about 400,000 tons in 1989. A brief decline in 1985 was caused by a somewhat weakened economy. Production of text papers was over 200,000 tons in 1989 and represented about 65% of this market.

RECYCLED PRINTING/WRITING PAPER MILLS

Company	Mill	Capacity*	Wastepaper content (%)	Grades
Appleton Papers	West Carrollton, Ohio	122,000 tpy	50%	Carbonless
Beckett Paper[1]	Hamilton, Ohio	160 tpd	50	Vellum opaque, other
Boise Cascade	Vancouver, Wash.	50 tpy	n.a.	Carbonless
Champion International	Hamilton, Ohio	n.a.	50	Uncoated, coated free-sheet
CPM Inc.	Claremont, N.H.	11,440 tpy[2]	50-100	Kraft/white envelope, school construction
	East Ryegate, Vt.	17,160 tpy[2]	50-100	Envelope, other
Cross Pointe[3]				
Miami Paper	West Carrollton, Ohio	110,000 tpy	50	Book, cover and text, 25% cotton, opaque
Flambeau	Park Falls, Wis.	133,500 tpy	50	Cover and text
Domtar	St. Catharines, Ont.	250 tpd	100	Writing, envelope stock
Eastern Fine Paper	Brewer, Maine	64,000 tpy	50	25% cotton, offset, mimeo, copy
Exton Paper Mftrs.	Modena, Pa.	60 tpd	n.a.	Kraft for envelope, wrapping, etc.
Fraser	Thorold, Ont.	102,000 mtpy	5**/50[4]	Canada Xerox copy paper
Fox River Paper	Appleton, Wis.	35,570 tpy	100[5]	Cotton, cover, opaque, typewriter
French Paper	Niles, Mich.	18,000 tpy	50+	Cover and text
Georgia-Pacific	Gilman, Vt.	71,000 tpy	50	Copy
	Kalamazoo, Mich.	140,000 tpy	50	Copy
P.H. Glatfelter	Neenah, Wis.	135,000 tpy	50	Book, writing, envelope, film-coated offset
Hopper Paper[6]	Taylorville, Ill.	37,000 tpy	50	Cover and text, writing
Howard Paper Mills	Dayton, Ohio	225 tpd†	50	Cover, text, bond, specialty
	Urbana, Ohio	†	5+**/50	Cover, text, bond, specialty
IP/Hammermill	Oswego, N.Y.	74,760 tpy	10**/40/50	Copy, cotton
Island Paper Mills	New Westminster, B.C.		50	Uncoated wood-free
James River	Adams, Mass.	40 tpd	50+**	Writing Papers
	Camas, Wash.	1,450 tpd	30[7]	Unbleached kraft copy paper
	Warren Glen, N.J.	75 tpd	50+**	Cover
	Ypsilanti, Mich.	17,800 tpy	50+**	Cover and text
Kerwin/Riverside	Appleton, Wis.	42,600 tpy	50/100	Writing bond, tablet, school construction
Lyons Falls	Lyons Falls, N.Y.	76,000 tpy	50	Book, reply card, tablet, forms, specialties
Manistique Papers	Manistique, Mich.	35,500 tpy	100	Groundwood specialties
Nekoosa Papers	Nekoosa/Port Edwards, Wis.	160,200 tpy[8]	10**/50	Copy
Niagara of Wisconsin	Niagara, Wis.		50+**	Coated publication—50-, 60-, 70-lb
Noranda Forest	Thorold, Ont.	102,000 mtpy	50[9]	Book, forms, copy, envelope, tablet
Patriot Paper[10]	Boston, Mass.	55,000 tpy	10**/50	Copy, book, offset, cover
Potsdam Paper Mills	Potsdam, N.Y.	65,000 tpy	40+	Opaque offset, writing, book
Putney Paper	Putney, Vt.	25,000 tpy	up to 100	MG/MF printing, coated book, ledger, thin

Continued

THIN PAPERS

Thin paper grades consist primarily of one-time carbonizing (OTC) tissue (99% of thin paper shipments in the U.S), plus cigarette and condenser papers, Bible paper, and papers for specialized uses such as lens cleaning and stencils.

Demand for OTC paper has declined as the use of carbonless for multipart forms increases. In fact, total shipments of thin papers dropped somewhere between 10% and 15% in 1989 from 1988, accounting for just 80,000-plus tons of paper. Carbon paper is produced by coating carbon black or pigments onto a bleached or unbleached basesheet with a converter and then combining the basesheet with a bond sheet.

RECYCLED PRINTING/WRITING PAPER MILLS (continued)

Company	Mill	Capacity*	Wastepaper content (%)	Grades
Repap Wisconsin	Kimberly, Wis.	1,400 tpd	50/20%**	No. 4 coated groundwood
Rolland	St. Jerome, Que.	400 tpd	50-100	Uncoated wood-free
Simpson Paper	Plainwell, Mich.	250 tpd	10**/50	Coated
	Pomona, Calif.	120,000 tpy	25-60[11]	Copy
	Ripon, Calif.	39,000 tpy	25-60[11]	Copy
	Vicksburg, Mich.	35,000 tpy	25-60[11]	Copy
Shoreham Paper[12]	Watervliet, Mich.	40,000 tpy	50-85	Coated and uncoated book offset
Strathmore[1]	Westfield, Mass.	160 tpd[13]	50	Bond, 20% cotton
Valentine Paper	Lockport, La.	49,840 tpy	50	Offset, tablet, reply card
Ward Paper	Merrill, Wis.	35,000 tpy	100	Watermarked bond, mimeo, duplicator
Westvaco	Tyrone, Pa.	87,220 tpy	50	Envelope paper
Geo. A. Whiting	Menasha, Wis.	9,000 tpy	80 avg.	Cover and text
PROPOSED				
Cascades/Steinbeis	East Angus, Que. or Niagara Falls, N.Y.	50,000 tpy	100	Uncoated office papers
Daishowa[14]	Port Angeles, Wash., Quebec City, Que.	n.a.	30	Directory
James River	Green Bay, Wis.	n.a.	n.a.	Printing/writing
Mi Ho Paper	St. Joseph, Mo.	124,000 tpy	50/100	Fine papers
Simpson Paper	Anderson, Calif.	420 tpd	n.a.	Coated publication
Westbrook Wood	Klamath Falls, Ore.	200,000 tpy	50	Lightweight coated
International Paper	n.a.	n.a.	n.a.	Coated groundwood by year-end 1991
CLOSED				
Performance Papers	Kalamazoo, Mich.	250-300 tpd	Closed	Book, other
Georgia-Pacific/Hopper	Reading, Pa.	20,000 tpy	Closed	Cover and text, writing
Sorg Paper	Middletown, Ohio	74,750 tpy	Converted	Converted to tissue, towel

n.a. = not available or not applicable.
*Total mill capacity, except as noted.
**Postcommercial, deinked, and/or postconsumer wastepaper
† 225 tpd combined for both mills; includes nonrecycled grades. Minimum 5% postconsumer in some grades.
1. Division of Hammermill Papers/International Paper.
2. Estimated average: Claremont produces 40 tpd and East Ryegate 60 tpd operating five to six days a week.
3. Subsidiaries of Pentair Inc.
4. 5% minimum postconsumer. Other grades: coated label, C1S packaging, wallpaper substrates, drawing, envelope, tablet, and register.
5. 100% recycled: 10% to 15% postconsumer waste.
6. Separate operating company of Georgia-Pacific Corp. Will be using 50% postconsumer in 1990.
7.30% postindustrial unbleached kraft paper from converters.
8. Less than 50,000 tpy recycled.
10. 5% postconsumer, 45% postcommercial.
11. Patriot Paper Corp. to revitalize, reopen mill in September 1990. Will use deinked fibers.
12. 25%, 50%, and 50% plus 10% postconsumer
11. Formerly Watervliet Paper.
12. Total of Turner's Falls, Westfield, Woronoco, and Millers Falls mills.
13. Plans to install deinking plants at Port Angeles and Quebec City; already producing some recycled directory at Quebec City.
Sources: Company data, E.H. Pechan & Associates Inc., *Pulp & Paper Week*, *Pulp & Paper Forecaster*, Canadian Pulp & Paper Assn.

Basis weights for thin papers vary widely, but a typical weight (20 x 30 in., 500 sheets) is 8.65 lb. The sheet is made on a yankee fourdrinier paper machine at medium speeds of 2,000 fpm. Chemical furnish is used, and it is refined to form a tight sheet devoid of pinholes.

Cigarette papers are highly filled lightweight papers made largely from flax straw. The controlled burning rate is accomplished by heavily filling the paper with PCC. Conventional cigarettes use three types of paper. Principal producers in the U.S. are P.H. Glatfelter Co.'s Ecusta Paper Div. and Kimberly-Clark Corp.'s Schweitzer Div. Cigarette smoking in the U.S. has declined because of government restrictions, such as those banning smoking on all domestic U.S. flights of less than six hours' duration, and repeated health warnings.

Production of thin papers has continued declining from previous years. However, at least one papermaker is bullish on prospects for lightweight printing and cigarette papers. "We don't see any reason to anticipate that business won't continue strong throughout the balance of [1989]," said M.A. Johnson, executive vice president/treasurer/chief financial officer for Glatfelter. The company's Ecusta Div. produces about 300 tpd of thin, fine, and specialty technical papers at its Pisgah Forest, N.C., mill. Johnson said that exports are pushing cigarette paper sales now that certain trade barriers have been reduced or eliminated with Japan, Rep. Korea, and other countries.

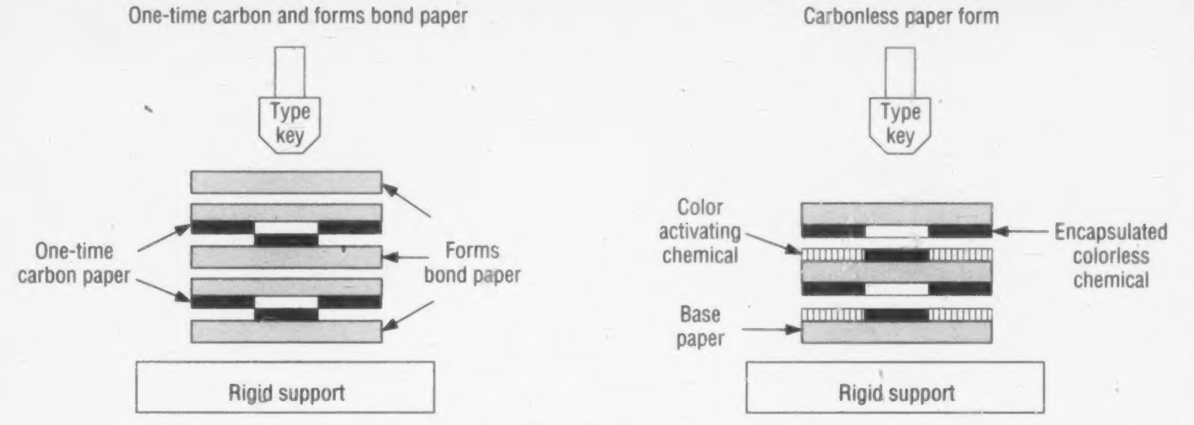
Elimination of trade barriers is important because cigarette smoking is declining in the U.S. at about 1% to 2%/year, according to Seth Moskowitz, public relations representative for R.J. Reynolds Tobacco Co. USA.

Bible and other thin printing papers are growing very slowly, said Jack Sweitzer, director of market research at K-C's Schweitzer Div. Yet imports, not including cigarette grades, are rising.

Despite the drop in demand for most thin paper grades, prices have remained stable. However, production costs are growing faster than some prices. And compared with the number of price increases for all printing/writing grades since 1986, prices for thin papers have not kept pace.

Electrical paper includes several grades such as insulating, condenser, capacitor, and dielectric. Production of these papers probably is less than 20,000 tpy combined. However, some electrical papers, such as insulating paper, are listed under "special industrial papers," and their tonnages are discussed elsewhere in the book.

STRUCTURE OF ONE-TIME CARBON AND FORMS BOND PAPER VS CARBONLESS PAPER



Paper:

COTTON-FIBER

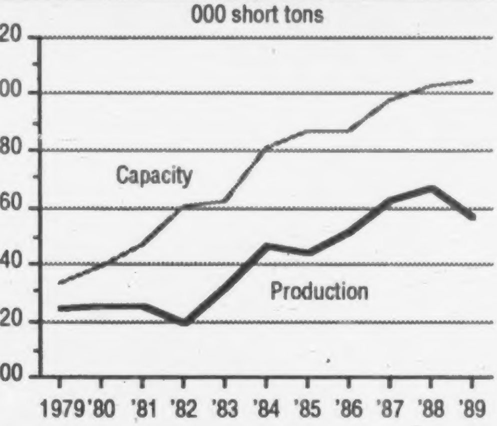
Papers in this category contain between 25% and 100% cotton fiber. They are primarily premium-quality bond papers plus technical and specialty papers requiring permanence and durability, such as paper currency, financial certificates, and postage stamps.

Fiber comes from new cotton cuttings from the textile and garment industries. Fabric sources include unbleached muslin, white shirt cuttings, light prints, and blue denims. Fiber also comes from cotton linters, which are the short fibers adhering to cotton seed after the ginning operation. Cotton linters consist of the stumps or bases of the longer staple textile fibers and short fuzz fibers. Old rags are not as common a source as they were when the paper was called "rag bond."

Cotton is the purest natural form of cellulose (98% to 99% alpha content), whether in the form of cotton linters or staple fibers used in the textile industry. This high cellulose content gives cotton-content paper its durability. The cotton fiber is usually blended with sulfate or sulfite woodpulp, which is then highly refined or beaten to develop a sheet with crackle and good strength. It is sized internally (beater sizing) to produce a proper level of holdout to inks. For a cockle finish, the sheet is air-dried.

Cotton-content papers are sold in basis weights of 9, 13, 16, 20, and 24 lb (17 x 22 in., 500 sheets). They are also labeled according to sheet finishes, such as light cockle, cockle, smooth, vellum, and linen. In addition, they are categorized according to their colors and sheet properties, such as whiteness, opaqueness, and onionskin.

CAPACITY AND PRODUCTION, 1979-89



Source: American Paper Institute.

COTTON-CONTENT PAPERS: GRADE DISTRIBUTION

(short tons)

Year	Total cotton-fiber	Bond and writing
1990e	167,000	102,000
1989r	157,000	104,000
1988r	167,000	113,000
1987r	163,000	136,100
1986	152,000	125,400
1985	144,100	117,400
1984	147,200	119,400
1983	132,700	105,900
1982	120,200	94,800
1981	125,600	95,300
1980	126,300	95,200
1979	124,600	93,100
1978	114,400	84,400

r = Revised.
e = *Pulp & Paper Forecaster* estimate.
Sources: American Paper Institute; Dept. of Commerce.

Fewer than 20 companies produce significant tonnage of cotton-fiber papers. These mills are usually small and based in the Northeast and upper Midwest. Because most of these mills can also produce bond-type grades from 100% chemical-pulp furnish, production is controlled mainly by demand rather than by capacity. (Sorg Paper Co. used to produce some cotton-content paper, but the company was reorganized to focus on specialty grades, dropping printing/writing papers.)

Demand for cotton-content paper, as measured by shipments, has grown or declined appreciably in recent years. Dept. of Commerce figures show 1978 shipments at 114,400 tons, rising to 144,100 tons in 1985 and to 162,800 tons in 1987. The American Paper Institute estimated shipments at 167,000 tons in 1988 and at 157,000 tons in 1989, a 6.3% loss.

Production (shipments) is likely to grow about 2.4% annually between 1989 and 1998, compared with 2.6% annual growth from 1979 to 1988. Much of that growth will be in bond and writing grades, rather than in technical and specialty grades.

Operating rates have been below 90% since 1980. They are expected to dip below 85% until 1992, when they will rebound slightly and remain at about 85% until 1996.

Cotton-bond pricing had its biggest leap in 1980, with 25% cotton bond in sheets moving to a yearly average of $1,442/short ton from $1,274/ton in 1979. Subsequent years brought increases varying from 7.4% to a mere 0.6% in 1983 to no effective increase in 1986. The price for 25% cotton in sheets rose to an average $1,810/ton by year-end 1984, and it hit $2,200/ton in 1989, followed by a modest increase in 1990.

U.S. capacity has remained relatively flat for the past 15 years. API forecasts capacity to increase by 5,000 tpy in 1990 and by only 2,000 tons in 1991. Total U.S. capacity in 1991 will be about 212,000 tpy.

NORTH AMERICAN PRODUCERS OF COTTON-CONTENT PAPERS

	Company/mill	Capacity[1] (tons/day)
1	Howard Paper Mills, Dayton, Ohio	225
2	Strathmore Paper, Turners Falls, Millers Falls, Westfield, and Woronoco, Mass., mills[2]	200
3	Crane & Co., Dalton, Mass.[3]	200
4	Eastern Fine Paper, Brewer, Maine[4]	180
5	Kimberly-Clark., Neenah, Wis.[5]	175e
6	Beckett Paper, Hamilton, Ohio[2]	150
7	Gilbert Paper, Menasha, Wis.[6]	95
8	Fletcher Paper, Alpena, Mich.[7]	85
9	Monadnock Paper Mills, Bennington, N.H.	75
10	James River-Fitchburg, Fitchburg, Mass.	60
11	Domtar, Fine Paper Div., Beauharnois, Que.	55
12	Rising Paper, Housatonic, Mass.	50
13	Curtis Paper, Newark, Del.[8]	38
14	Simpson Paper, Harding-Jones mill, Middletown, Ohio	30
15	NVF, Holyoke, Mass.[9]	28
16	Southworth, W. Springfield, Mass.	24
17	Esleeck Mfg., Turners Falls, Mass.	20

e = Estimate.

1. Total mill capacity including fine papers.
2. Division of Hammermill Papers Co.
3. Includes Byron Weston Papers, Dalton, Mass.
4. 35% of production is cotton. Division of Preco Corp.
5. Includes Whiting mill in Stevens Point, Wis.
6. Division of Mead Corp.
7. Actual cotton production lower.
8. Division of James River Corp.
9. Parsons Paper Div.

PRICING TRENDS FOR BOND PAPERS

($/short ton)

Year	Forms bond[1]	25% cotton[2]
1990		
2Q	$(820-860)	$2,200
1Q	(820-860)	2,200
1989		
4Q	(800-860)	2,200
3Q	(840)/910	2,200
2Q	(880)/910	2,200
1Q	(880)/910	2,200*
1988		
4Q	(880)/910	2,200*
3Q	850/870	2,200
2Q	850/870	2,125
1Q	800-810	2,125
1987		
4Q	760	1,990-2,060
3Q	760	1,900
2Q	720*	1,810
1Q	720*	1,810
Year-end		
1986	672	1,810*
1985	(640)	1,810
1984	762	1,750
1983	745	1,650/1,730
1982	(640)	1,650
1981	753*	1,549
1980	697	1,490
1979	620	1,343
1978	544	1,210
1977	475	1,143
1976	520	1,083
1975	500	1,012
1974	470	984
1973	—	728
1972	—	719

( ) Estimated transaction price where significant volume moving below list.
* = Discounting from list prices reported.
1. Average price for rolls.
2. Average price for sheets.
Sources: *Pulp & Paper Week; Pulp & Paper Pricebook2.*

Paper:

BRISTOLS

Bristol papers are bleached or semibleached kraft stock, slightly lighter in weight than bleached boards but heavier than true printing/writing grades. Bristols may be solid or laminated stock with thickness or caliper ranging from 6 to 15 pt.

Bristol grades are broken down into seven segments: tabulating index; tag and file folder; index bristols; printing bristols; postcard; coated bristols; and mill or bogus bristols, which are bristol-type recycled paperboards made on cylinder paper machines.

Tabulating stock, used primarily for computer tab cards, must have superior dimensional stability and electrical characteristics. It is produced on fourdrinier paper machines from semibleached kraft pulps.

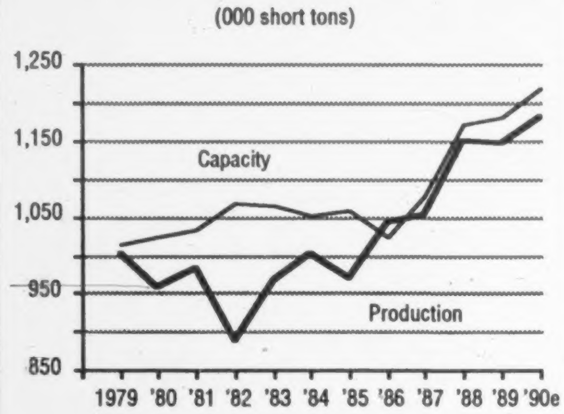
Index bristols have a fairly good printing surface that is extremely erasable. Both tag and index bristols are usually produced on fourdrinier paper machines. Although both grades are similar, tag bristol is stronger and more durable.

Printing bristols are used in a variety of ways. They can be either coated one side or uncoated, and many have characteristics similar to other cover grades. Lower-caliper (between 6 and 10 pt) coated bristols are produced on fourdrinier paper machines from a blend of bleached hardwood and softwood kraft pulps. Hardwood improves the printing surface and adds bulk.

Coated bristols have end uses such as calendars, greeting cards, and directory covers, and they account for approximately half of total bristol tonnage. Generally, coated bristol grades are produced at large, integrated mills that also produce bleached paperboard or free-sheet paper grades.

Bristols produced from recycled fibers are typically

CAPACITY AND PRODUCTION, 1979-90



e = Estimate.
Sources: American Paper Institute, *Pulp & Paper* estimates.

U.S. STATISTICS FOR BRISTOLS

	1990e	1989	1988	1987
Production, 000 tons	1,183	1,148	1,150	1,052
Capacity, 000 tons	1,220	1,183	1,171	1,079
Utilization rate, %	97.0	97.0	98.2	97.5
Imports, 000 tons	5.0	4.8	4.2	3.6
Exports, 000 tons	1.0	1.1	1.5	1.9
Apparent U.S. consumption				
000 tons	1,187	1,152	1,153	1,054
lb/capita	9.6	9.4	9.4	8.7
000 tons/billion $ real GNP (1982)	0.30	0.29	0.28	0.25

e = Estimate
Sources: American Paper Institute, *Pulp & Paper* estimates.

heavier stock and extend the caliper range from 15 pt and higher. They are produced by several smaller companies making specialty paperboard.

Major producers of bristol grades include International Paper Co., Federal Paper Board Co. Inc., Temple-Inland Inc., Union Camp Corp., James River Corp., Champion International Corp., and several smaller mills. Specialty Paperboard Inc., formerly a division of Boise Cascade Corp., is a major manufacturer of 100%-recycled bristol grades used in the manufacture of office products.

OUTLOOK

Overall demand for bristols has grown slowly in recent years, rising about 1%/year during the past decade. The main reason for this sluggish growth is the sharp drop in the market for tabulating card stock, which fell from about 500,000 tons in 1970 (almost half of total tonnage) to only about 30,000 tons in 1989. Excluding tab card, demand for bristols has grown a respectable 5% annually during the last decade, but the growth trend has flattened in the past two years.

About 1.150 million tons of bristols were produced by U.S. mills in 1989, virtually the same output as in 1988, according to the American Paper Institute. Mill operating rates averaged about 95% in both 1988 and 1989, down from about 97% in 1987. Because several bleached board producers are selling their products in bristol markets, API attributed the recent decline in operating rates to the transfer of some bleached board capacity to bristol capacity.

Demand for coated and uncoated printing bristols is growing across a wide range of applications, including paperback book and directory covers, greeting cards, promotional inserts, and direct mail materials. Sales of uncoated lottery and airline ticket stock are also enjoying strong market growth, as are most other segments of the commercial printing field.

The big decline in tabulating card stock reflects displacement by new computer systems that have made tab cards obsolete as a method of data entry and storage. However, this decline has been partially offset by the growth of the ubiquitous office file folder. The rapid growth of the nation's service economy—including finance, communications, retail, and wholesale trade—has fueled the demand for office supplies.

Shipments of bristols for file folders increased from 72,000 tons in 1970 to 221,000 tons in 1989. Index cards, another office supply stalwart, have been slightly weaker. Shipments in 1989 dropped to 108,000 tons from 117,000 tons in 1988. Coated printing bristols have shown the strongest growth, rising from 190,000 tons in 1970 to 493,000 tons in 1989.

According to Communication Information Services Inc., a market research firm based in Pleasant Hill, Calif., overall demand for bristols should rise at a 2.3% annual rate during the 1986-95 period, compared with a 1% annual rate during 1976-85. Coated bristols may grow at a somewhat higher 4.4% annual rate.

U.S. CAPACITY TRENDS FOR BLEACHED BRISTOLS

Year	Annual capacity (000 short tons)	Change (%)
1990e	1,220	3.1%
1989	1,183	1.0
1988	1,171	8.5
1987	1,079	5.3
1986	1,025	-3.2
1985	1,059	0.7
1984	1,051	-1.3
1983	1,065	-0.4
1982	1,069	3.3
1981	1,035	4.0
1980	1,024	0.8
1979	1,016	-14.9
1978	1,194	-1.6
1977	1,213	4.1
1976	1,165	—

e = Estimate.
Sources: American Paper Institute, *Pulp & Paper* estimates.

BLEACHED BRISTOL PRODUCTION BY GRADES

(000 short tons)

Year	Total	Tabulating	Tag	Folder	Index, printing, postcard	Coated
1989	1,148	18	170	200	260	500
1988	1,150	40	185	195	280	450
1987	1,052	50	181	188	276	350
1986	1,043	60	182	178	270	360
1985	970	70	200	164	194	266
1984	1,003	68	214	141	215	302
1983	967	107	215	149	240	217
1982	886	123	181	117	200	213
1981	984	142	194	127	330	290
1970	1,155	500	186	72	218	179
% change 1970-89	-0.6	-96.4	-8.6	177.7	19.3	179.3

Source: *Pulp & Paper* estimates.

Capacity increases have been gradual in recent years, following declines in the 1970s that kept the market tight. In 1979, when capacity fell to a low of just over 1 million tons, the operating rate reached a high of 104.6%. In 1989, capacity remained at about 1.168 million tons. API estimates that industry capacity will rise to 1.202 million tons by 1991. Bristol capacity is somewhat hard to pinpoint, however, because of the sometimes arbitrary delineation between bristols and other grades, including uncoated free-sheet, bleached board, cover/text, and boxboard. Most industry observers suspect that bristol capacity is somewhat higher than is officially reported.

Market leaders Federal Paper Board and International Paper produce both coated bristols and lightweight

PRODUCERS OF BRISTOL GRADES

Mill bristol*

Beveridge Paper Co.
Indianapolis, Ind.

Boise Cascade Corp.
Sheldon Springs, Vt.
Beaver Falls, N.Y.

Byron Weston Co.[1]
Dalton, Mass.

Lowe Paper Co.
Ridgefield, N.J.

Sonoco Products Co.
Holyoke, Mass.

Index/printing

Boise Cascade Corp.
Brownville, N.Y.
Beaver Falls, N.Y.

Champion International Corp.
Hamilton Ohio

Domtar Inc.
St. Catharines, Ont.
Toronto, Ont.
Beauharnois, Que.

E.B. Eddy Forest
Products Ltd.
Brewer, Maine
Hull, Que.

Federal Paper Board Co. Inc.
Augusta, Ga.
Riegelwood, N.C.

Fox River Paper Co.
Appleton, Wis.

Mead Corp.
Gilbert Paper Co.
Menasha, Wis.

International Paper Co.
Bastrop, La.
Moss Point, Miss.

James River-Fitchburg
Fitchburg, Mass.
Milford, N.J.

Kimberly-Clark Corp.
Neenah, Wis.

Mohawk Paper Mills Inc.
Cohoes, N.Y.
Waterford, N.Y.

Plainwell Paper Co.
Plainwell, Mich.

Rising Paper Co.
Housatonic, Mass.

Rolland Inc.
St. Jerome, Que.

Scott Paper Co.
Mobile, Ala.

Simpson Paper Co.
Vicksburg, Mich.
Miquon, Pa.

Sorg Paper Co.
Middletown, Ohio

Strathmore Paper Co.[2]
Westfield, Mass.

Temple-Eastex Inc.
Evadale, Texas

Union Camp Corp.
Franklin, Va.

Wausau Paper Mills Co.
Brokaw, Wis.

Whiting Paper Co.
Menasha, Wis.

Tag

Boise Cascade Corp.
Brownville, N.Y.
Beaver Falls, N.Y.

Domtar Inc.
St. Catharines, Ont.
Toronto, Ont.

International Paper
Bastrop, La.
Georgetown, S.C.

Island Paper Mills Inc.[3]
New Westminster, B.C.

James River-Fitchburg Inc.
Fitchburg, Mass.

James River Corp.
Warren Glen, N.J.
Milford, N.J

Merrimac Paper Co.
Lawrence, Mass.

Potlatch Corp.
Lewiston, Idaho

Rolland Inc.
Mont Rolland, Que.

Simpson Paper Co.
Miquon, Pa.

Sorg Paper Co.
Middletown, Ohio

Temple-Eastex Inc.
Evadale, Texas

Union Camp Corp.
Franklin, Va.

Postcard

Domtar Inc.
Cornwall, Ont.

Eastern Fine Paper Inc.[4]
Brewer, Maine

Hennepin Paper Co.[5]
Little Falls, Minn.

International Paper Co.
Mobile, Ala.
Ticonderoga, N.Y.

James River Corp.
Hyde Park, Mass.
Hughesville, N.J.

Lowe Paper Co.
Ridgefield, N.J.

Pejepscot Paper
Brunswick, Maine

Sorg Paper Co.
Middletown, Ohio

Wausau Paper Mills Co.
Brokaw, Wis.

* Includes bogus bristols and heavyweight bristols from bleached kraft used for posters, etc.
[1] Division of Crane & Co. Inc.
[2] Division of Hammermill Paper Co.
[3] 50% owned by MacMillan Bloedel Ltd., 50% owned by Fraser Inc.
[4] Division of Eddy Paper Co. Ltd.
[5] Subsidiary of Carlyle Investment Corp.

bleached paperboard at large, integrated mills in the South. The companies often shift production between the two grades when they are made on the same machine. Both companies are making investments to improve their positions in the bristol market.

Federal will spend nearly $400 million to install a new lightweight coated bleached paperboard machine at its Augusta, Ga., mill in 1992. The new machine will produce primarily bleached bristol grades for the commercial printing industry. The project will add approximately 650 tpd, or 235,000 tpy, increasing the Augusta mill's total capacity to about 2,510 tpd, or 900,000 tpy.

IP will invest $28 million in its coated bristol machine at Moss Point, Miss., to improve quality and raise output. IP plans to broaden its Springhill coated bristol line over a two-year period by adding several new weights. Current debottlenecking and expansion projects at IP's Georgetown, S.C.; Texarkana, Texas; and Bastrop, La., mills will increase uncoated bristol capacity by about 20% by 1991.

Bristol prices hold up better than prices for other related grades of paper and paperboard, which are more vulnerable in economic slowdowns. During the 1981-82 recession, pricing for bristol grades was substantially stronger compared with other sectors that suffered from heavy discounting. In fact, some bristol price increases were implemented in early 1982—a time when almost no other printing/writing grades went up in price.

When the economy began recovering in late 1983, coated bristols rebounded sharply, posting a $50/ton price hike effective Jan. 1, 1984. However, weakening in the overall printing/writing papers market later that year caused some price weakness in bristols. Demand picked up in 1986, and a $20/ton price increase went into effect in September and again in October. Additional increases of $40 to $50/ton were implemented in the spring and fall of both 1988 and 1989.

Prices of coated printing bristols and uncoated bristols used in file folders, tabulating cards, tag stock, airline and lottery tickets, etc., remained firm in 1989 and through the first half of 1990. Prices vary considerably among bristol grades because of different end uses, basis weights, and printing and converting requirements. In early 1990, coated bristol prices ranged between $1,050 and $1,150/ton, manila file folder stock prices averaged about $710/ton, and manila tag stock sold for about $850/ton.

BRISTOLS: TYPICAL GRADE STRUCTURE

Grade	Uses, basis-weight ranges	
INDEX: (uncoated)	Sales lists, manuals, record folders, file cards.	
	Basis:	25½ x 30½ in., 500
	Weights:	80 lb (145 g/m²)
		90 lb (163 g/m²)
		110 lb (199 g/m²)
		140 lb (253 g/m²)
		170 lb (307 g/m²)
		220 lb (398 g/m²)
TAG: (uncoated)	Tags, ruled forms, timecards, menus, folders, catalog inserts, display cards.	
	Basis:	24 x 36 in., 500
	Weights:	90 lb (146 g/m²)
		100 lb (163 g/m²)
		125 lb (203 g/m²)
		150 lb (244 g/m²)
		175 lb (285 g/m²)
		200 lb (325 g/m²)
POSTCARD[1]: (uncoated)	Return mailers, bills/statements.	
	Basis:	22½ x 28½ in., 500
	Weights:	57 lb (125 g/m²)
		67 lb (147 g/m²)
		80 lb (176 g/m²)
MILL BRISTOLS[2]: (uncoated or C1S)	Promotional folders, posters, point-of-purchase displays, tent cards, covers, etc.	
	Caliper:	0.008 in.
		0.010 in.
		0.012 in.
		0.015 in.
		0.018 in.
		0.020 in.
		0.024 in.

1. Approximate calipers: 0.009 in. for 67 lb, 0.0075 in. for 57 lb.
2. A wide range of grades, including bogus bristols. The higher-caliper grades, above 15 pt, could be produced on cylinder machines. Also available in higher calipers.

BLEACHED BRISTOLS: U.S. PRICE HISTORY*

Year	Manila tag[1]	Manila file folder	C1S[2]
1989	$850	$710	$980-1,030
1988	755	620	840-930
1987	715	585	800
1986	715	585	800
1985	675	640	760
1984	675	640	760
1983	675	576	720
1982	581	576	670
1981	581	576	640-670
1980	521-546	521-541	565-585-605
1979	481	481	520

*Published list prices; years with multiple prices include more than one price increase that year.
1. Rolls, greater than or equal to 125-lb basis weight (24 x 36, 500 sheets).
2. Coated one side, 10-pt. caliper.

Paper:

PACKAGING AND INDUSTRIAL CONVERTING

Kraft packaging and industrial converting papers include a wide range of unbleached and bleached papers and are divided into three general categories: 1) unbleached packaging and industrial converting grades used for grocery bag and sack, shipping sack, wrapping, and other converting papers; 2) bleached packaging and industrial converting grades used for similar end uses; and 3) special industrial papers used in the manufacture of abrasives, electrical insulators, gaskets, filters, and other products. The bleached grades also include glassine, grease-proof, and vegetable parchment papers used for specialty packaging.

Unbleached grades make up nearly 60% of total production, while bleached and specialty packaging grades account for about 20%, and special industrial grades represent about 20%. The most commonplace products made from kraft paper are grocery sacks, shipping sacks, and retail merchandise bags. The four major end uses for unbleached and bleached kraft packaging and industrial converting papers are bag and sack (57% of shipments), shipping sack (25%), wrapping (3%), and other converting (15%).

U.S. STATISTICS FOR PACKAGING AND INDUSTRIAL CONVERTING PAPERS

	1990e	1989	1988	1987
Production[1], 000 short tons	4,665	4,925	5,047	4,955
Capacity[1], 000 short tons	5,100	5,239	5,394	5,492
Utilization rate, %	91.5	94.0	93.6	90.2
Imports, 000 short tons	430	407	343	310
Exports, 000 short tons	272	342	347	294
Apparent U.S. consumption				
000 short tons	4,823	4,990	5,043	4,971
lb/capita	38.2	40.2	41.1	40.9
000 tons/billion $ real GNP (1982)	1.18	1.2	1.29	1.30

e = Estimate.

[1] American Paper Institute, *Pulp & Paper* estimates.

Kraft papers for bag and sack production are made in many basis weights. Small bags designed to hold 1/4 lb to 25 lb of product are made from paper with basis weights of 30, 35, or 40 lb/3,000 ft^2—equivalent to 49 to 65 g/m^2. In contrast, sacks are designed to hold more product, and they are made from paper with basis weights of 40 to 80 lb/3,000 ft^2 or 65 to 130 g/m^2. Typical sack weights are 40, 52, 57, 65, 70, 75, and 80 lb. Standard grocery sacks use 70-lb kraft paper, while 50-lb paper is used in shipping sacks.

Because bags and sacks are made for many different purposes, their weight, style, and construction are tailored to each end use. Bags and sacks are standardized in four sizes (1/8, 1/6, 1/5, and 1/4 of a bushel), and they are primarily produced in one of four styles: flat, gusset, satchel-bottom, and self-opening. Sack construction may also be single-wall, heavy single-wall, duplex, or multiwall. If needed, the machine-direction (MD) strength of kraft paper may be increased during the drying stage of the papermaking process. This extensible kraft paper absorbs more shock without rupturing, and it is used primarily in multiwall shipping sacks.

Multiwall shipping sacks are made of two or more plies of kraft paper, which can be combined with plies of plastic film or other barrier materials. Typically, multiwall shipping sacks hold a minimum weight of 25 lb and are used to ship bulk products such as cement, chemicals, and agricultural products. Multiwall sacks provide an economical packaging system. Because the layers of kraft paper and plastic film are lightweight, shipping costs are based mostly on product weight alone, and because the multiwall bag is flexible and strong, it can be stacked and pallet-loaded for shipment. Some smaller-size multiwall bags are also used to package coffee, sugar, flour, pet food, and charcoal briquettes for consumer markets.

Merchandise bags are specialized bags commonly used by department stores and other retail businesses. Typically, these bags are bleached and printed. Bleached kraft papers that are machine-finished (MF) or machine-glazed (MG) have an excellent glossy printing surface and are used when the appearance of bags or wrapping paper is important.

Wrapping and other converting grades include specialty papers that are often lightweight (25 lb or below) and coated or laminated for moisture, vapor, or grease resistance.

INDUSTRY STRUCTURE

The structure of the packaging and industrial converting industry is fragmented because of the wide range of grades produced. Commodity unbleached kraft bag and sack paper grades are produced mainly at integrated mills in the southeastern U.S., which may also produce kraft linerboard on the same paper machines. Some unbleached kraft paper is also produced in the Pacific Northwest and in western and eastern Canada.

The top three commodity producers of unbleached kraft papers are Stone Container Corp., Union Camp Corp., and Georgia-Pacific Corp. In the Pacific Northwest, Longview Fibre Co., Port Townsend Paper Co., and Simpson Paper Co. are the key producers. These large integrated paper companies also produce some specialty unbleached and bleached packaging and converting papers.

Most specialty and industrial papers typically are manufactured at small, nonintegrated mills concentrated in the Northeast and upper Midwest. James River Corp. is the major producer of these grades. Other producers of specialty papers include P.H. Glatfelter Co., Mosinee Paper Corp., CPM Inc., Wausau Paper Mills Co., Filtration Sciences Corp., Hollingsworth & Vose Co., and Dexter Corp.

Negative growth rates and low profitability in the commodity unbleached kraft paper segment have caused major industry restructuring through machine conversions and shutdowns and company divestitures. Stone Container has become the largest producer through its acquisitions of unbleached kraft mills formerly owned by Jacksonville Kraft Paper Co. and Continental Forest Industries Inc. At the same time, Stone became the largest integrated manufacturer of paper bags and sacks with its acquisitions of Samson Paper Bag Co., Great Plains Bag Corp., and Trinity Paper & Plastics Corp.

Meanwhile, Champion International Corp., International Paper Co., and Georgia-Pacific have substantially reduced their market position by converting paper machines from bleached and unbleached kraft paper production to mostly kraft linerboard and uncoated free-sheet production.

In the specialty packaging and industrial paper sector, James River expanded significantly during the past decade by acquiring several small, nonintegrated specialty paper companies, including Riegel Products Corp. (1977), Brown Co. (1980), Premoid Corp. (1986), Specialty Paper Co. (1986), and Dunn Paper Co. (1987). James River also acquired specialty converting plants from H.P. Smith Paper Co. (1983) and Crown Zellerbach Corp. (1986).

Meanwhile, other companies sold or shut down their specialty paper businesses, including Bemis Corp. (1977-86), Port Huron Paper Corp. (1983), and Philip Morris Inc. (1985). Thilmany Pulp & Paper Co. shut down two of its specialty paper machines in 1987.

In contrast to this trend, Longview Fibre Co. and Consolidated Papers Inc. are currently adding new paper machine capacity for lightweight specialty packaging papers. In recent years, demand for these grades has been very good for uses such as flexible food and consumer products packaging and labeling.

SUPPLY/DEMAND TRENDS

Production of packaging and industrial converting papers has steadily declined over the past ten years. Shipments increased slightly from 5.7 million tons in 1977 to a peak of 5.8 million tons in 1979, then declined to 4.9 million tons in 1989. This resulted in a negative annual growth rate of -1.4% during the period, compared with a 2.2% annual growth rate for all grades of paper and paperboard.

Most of the decline was in grocery bag and sack paper grades, which were displaced by plastic bags in about 50% of the nation's supermarkets. Bleached packaging paper shipments held relatively steady, while multiwall shipping sack papers rebounded recently after a ten-year decline. The overall poor performance was blamed on competition from plastic films in many packaging markets and lacklust-

U.S. TOTAL PRODUCTION AND CAPACITY OF PACKAGING AND INDUSTRIAL CONVERTING PAPERS

(000 short tons)

Year	Production	Capacity	Utilization rate (%)
1989	4,925	5,239	94.0%
1988	5,047	5,394	93.6
1987	4,955	5,492	90.2
1986	5,117	5,758	88.9
1985	5,205	5,985	87.0
1984	5,551	5,991	92.6
1983	5,498	6,078	90.4
1982	5,300	6,076	87.2
1981	5,433	5,947	91.4
1980	5,327	6,072	87.7
1979	5,708	6,053	94.3
1978	5,778	6,146	94.0
1977	5,930	6,242	95.0
1976	5,661	6,202	91.3
1975	4,804	6,368	75.4
1974	5,732	6,360	90.1
1973	5,694	6,060	94.0
1972	5,706	6,028	94.7
1971	5,443	5,963	91.3
1970	5,438	5,940	91.6
1969	5,520	5,840	94.5

Sources: American Paper Institute, *Pulp & Paper* estimates.

er industrial activity during the early 1980s.

Although kraft packaging and industrial paper production dropped steadily, operating rates remained close to 90% because of planned capacity reductions. Most of the decline in capacity was concentrated in the unbleached kraft segment of the industry. This trend is expected to continue but at a slower pace than in recent years. These scheduled capacity withdrawals, combined with modest growth in production capacity for specialty papers, should keep average operating rates above 90% for the next several years.

KRAFT PACKAGING PAPERS

U.S. unbleached kraft paper shipments peaked at 4.0 million tons in 1974 and then plummeted to 2.68 million tons by 1989. Most of the decline occurred during the period of 1984-87, when shipments decreased nearly 680,000 tons. Grocery bag and sack grades suffered heavy losses, while multiwall sack grades had smaller losses.

In contrast, shipments of bleached packaging papers for the same end uses actually increased. In 1989, bleached kraft paper shipments reached 467,000 tons, compared with shipments of 381,000 tons in 1982.

In 1989, the American Paper Institute reclassified 275,000 tons of unbleached kraft paper and 75,000 tons of bleached kraft paper capacity as specialty grades. The transfer did not affect the industry's total level of production, but it did establish lower 1988 output levels for unbleached kraft papers (2.8 million tons) and bleached kraft papers (465,000 tons).

Shipments of unbleached kraft paper grades in 1990 are expected to be down approximately 5%. Although the long-term decline in grocery bag and sack appears to have bottomed out, unbleached multiwall sack and converting grades are now showing weakness as a result of slowing industrial production.

Shipments of bleached and specialty packaging grades, which were steady in 1989, are expected to remain at the same level in 1990. New capacity will begin coming online at the end of 1990, and shipments should increase thereafter. Overall operating rates should remain above 90%, however, as producers continue "rationalizing" capacity between heavyweight grocery sack paper, lightweight linerboard, and specialty grades.

Since 1984, the industry has shut down about 550,000 tons of unbleached kraft paper production capacity, and it has shifted another 300,000 tons to kraft linerboard production. In 1984-85, Georgia-Pacific shut down two machines at Crossett, Ark., with combined capacity of about 175,000 tpy, and it converted production to uncoated free-sheet and bleached kraft paper grades. G-P also converted a 158,000-tpy kraft paper machine at Monticello, Miss., to linerboard

U.S. PRODUCTION AND CAPACITY OF PACKAGING AND INDUSTRIAL CONVERTING PAPER BY GRADES

(000 short tons)

	Unbleached kraft		Bleached kraft*		Special industrial paper	
Year	Production	Capacity	Production	Capacity	Production	Capacity
1989	2,681	2,854	1,078	1,123	1,166	1,495
1988	2,800	2,908	1,061	1,077	1,186	1,417
1987r	2,839	3,032	952	1,025	1,163	1,250
1986r	3,116	3,376	946	1,028	1,056	1,148
1985r	3,246	3,632	941	1,045	1,017	1,131
1984r	3,520	3,795	955	1,038	1,111	1,263
1983r	3,505	3,860	937	1,157	1,053	1,171
1982r	3,413	3,792	822	1,068	963	1,284
1981r	3,569	3,679	828	975	854	1,206
1980r	3,653	3,805	876	1,095	523	977
1979	4,096	4,098	993	1,105	531	850
1978	3,998	4,223	1,043	1,041	498	883
1977	3,936	4,317	1,002	1,069	524	856
1976	3,918	4,218	1,138	1,128	574	856
1975	3,374	4,333	965	1,194	440	841
1974	4,169	4,389	1,205	1,291	598	679
1973	3,902	4,138	1,205	1,292	610	629
1972	3,811	4,083	1,272	1,323	507	622
1971	3,649	4,031	1,242	1,383	438	549
1970	3,786	4,007	1,231	1,316	421	554
1969	3,780	4,006	1,297	1,275	443	559

*Includes glassine, greaseproof, and vegetable parchment.
r = Revised.
Sources: American Paper Institute, *Pulp & Paper* estimates.

production in 1985. That same year, International Paper shut down a 135,000-tpy machine at Mobile, Ala., for conversion to uncoated free-sheet and bleached kraft paper grades. In 1986, Champion International shut down its 236,000-tpy swing machine at Pensacola, Fla., for conversion to uncoated free-sheet. In 1989, the company shut down another machine that produced about 110,000 tpy of bleached cupstock and kraft packaging papers, and it plans to convert production to uncoated free-sheet. Additional conversions on a smaller scale were made during this period by other companies.

The most notable exception to this trend was Stone Container's reactivation of the former Jacksonville Kraft mill in 1987. Jacksonville's 125,000-tpy No. 1 machine currently produces 40- to 60-lb kraft sack and multiwall paper grades.

Grocery bags and sack is the single largest end-use market for unbleached kraft paper. Production of grocery bag and sack paper grew steadily during the first two decades after World War II due to the rapid growth of supermarket chains and the increased demand for large carryout sacks. By the 1970s, however, shipments of grocery bag and sack began leveling off as population growth rates flattened and as plastic bags began displacing kraft paper. The introduction of plastic grocery bags signaled the end of kraft paper's dominance of the carryout sack market.

Plastic's share of the grocery sack market rose from about 2% in 1976 to about 30% in 1987, and it increased to an estimated 50% in 1989. Paper sacks lost market share simply because plastic sacks became more cost-competitive. In 1976, a plastic sack was 110% of the cost of a paper sack. By 1980, the two products were at parity, and by 1987, the cost of a plastic sack was 60% that of a paper sack. Plastic's penetration may reach higher levels in the next few years; however, increasing criticism is being directed at all types of plastic packaging that adds to solid waste, including the plastic grocery sack.

Plastic sacks are more cost-competitive because of linear low-density polyethylene (LLDPE) and high-molecular-weight high-density polyethylene (HMW-HDPE) resins, which permit converters to down-gauge sacks and reduce raw material costs. The first plastic sacks developed a decade ago were more than 2.0 mil thick; today's sacks are in

ESTIMATED CAPACITY OF U.S. COMPANIES PRODUCING PACKAGING AND SPECIALTY PAPERS

Company	Annual capacity (000 short tons)	Grades
1. Stone Container[1]	773	Unbleached bag, sack, and converting
2. James River	535	Specialty packaging and industrial
3. Georgia-Pacific	355	Unbleached and bleached bag, sack, and converting
4. Union Camp	350	Unbleached and bleached bag, sack, and converting and saturating kraft
5. Longview Fibre	285	Unbleached and bleached bag, sack, and converting
6. Gaylord/Mid-America	270	Unbleached bag, sack, and converting
7. International Paper	260	Unbleached and bleached bag, sack, and converting
8. Gilman Paper	230	Unbleached and bleached bag, sack, and converting
9. Westvaco	200	Saturating kraft
10. Champion International	195	Unbleached and bleached bag, sack, and converting
11. Mosinee Paper	120	Specialty and industrial
12. Chesapeake	115	Unbleached bag, sack, and converting
13. Kimberly-Clark	115	Cigarette paper, specialty, and saturating kraft
14. Wausau Paper Mills[2]	105	Glassine, greaseproof, and specialty
15. Port Townsend	100	Unbleached bag, sack, and converting
16. Kapaco Group	90	Specialty and industrial
17. P.H. Glatfelter[3]	90	Cigarette paper and technical specialty
18. Hammermill[4]	85	Specialty and industrial
19. Simpson Tacoma Kraft	80	Unbleached and bleached bag, sack, and converting
20. Rolland-Fitchburg Paper[5]	70	Specialty and decorative
21. Willamette Industries	70	Unbleached bag, sack, and converting
22. Consolidated Papers	55	Specialty packaging
23. Hollingsworth & Vose	50	Specialty and industrial
24. CPM	35	Specialty and industrial
25. Filtration Sciences	30	Specialty and industrial
26. Schoeller Technical	30	Photographic and technical specialty
27. Mead Specialty Paper	25	Technical specialty

Note: Exact capacities for packaging papers are difficult to estimate because of swing machines in the industry, which can produce either linerboard or unbleached kraft packaging paper.
Estimates for specialty and industrial papers are based on published sources and may not include some printing/writing paper, thin paper, or tissue tonnage.

1. Includes Seminole Kraft Corp.
2. Includes Rhinelander Paper Co.
3. Includes Ecusta Corp.
4. Includes Thilmany Paper Co. and Nicolet Paper Co.
5. Subsidiary of Rolland Inc. (Canada).
6. Includes Detroit River Paper Co. and Watervliet Paper Co.

the range of 0.6 to 0.7 mil. (See Plastic Resins chapter.)

Competition between paper and plastic grocery sacks has had little dampening effect on kraft paper prices because prices for grocery sack paper are influenced more by linerboard prices than by plastic bag prices. Since some swing machines in the industry can manufacture either heavyweight grocery sack paper or lightweight linerboard, producers allocate machine time according to which grade gives them a better return.

A 1988 industry survey found that an average of 70,000 tons of kraft paper was produced on swing machines each month, representing about 30% of total kraft paper production. For the same period, an average of 232,000 tons of linerboard was produced on swing machines each month, representing about 13% of industry production. In 1989, average monthly swing production figures were close to the 1988 levels.

Most of these machines make a better return when they produce lightweight liner in a strong linerboard market. In this situation production costs are lower; therefore, kraft paper prices must remain competitive with linerboard prices to maximize mill profits. As a result, the price of 70-lb grocery sack paper increased about 18% in 1986 and 16% in 1987, while 26-lb linerboard prices increased about 18% in 1986 and 34% in 1987. In second-quarter 1988, prices of 70-lb grocery sack paper reached the $455 to $465/ton level. They climbed to between $495 and $505/ton in early 1989 and have remained near that level in 1990. Meanwhile, the price of 26-lb linerboard increased to about $460/ton in early 1989.

Kraft paper price increases in 1986-87 were not fully recovered through equivalent price increases for converted grocery bags and sacks, so profitability of converting operations suffered. By 1989-90, however, converted bag prices increased and margins were restored. The price gap between paper and plastic remains wide. In mid-1990, heavyweight one-sixth-size paper grocery sacks sold for over $40/thousand, compared with about $20/thousand for plastic grocery sacks.

Plastic will continue to grow at the expense of paper in the grocery sack market, but its penetration rate will be lower than in the past. Plastic could reach 75% penetration by the mid-1990s. However, shipments of unbleached grocery bag and sack paper stabilized in 1989 at about 1.6 million tons.

Another sign of life in the grocery bag and sack business is the entry of a major new supplier. Gaylord Container Corp. purchased two grocery sack plants in 1989 and will supply these plants from its kraft paper mill at Pine Bluff, Ark. The acquisitions make Gaylord the second-largest in-

U.S. PRODUCTION OF PACKAGING AND INDUSTRIAL CONVERTING PAPER—BY END USE[1]

(000 short tons)

	Wrapping paper			Shipping sack paper			Bag and other paper			Other converting		
Year	Total	Unbleached	Other[2]	Total	Unbleached	Other[2]	Total	Unbleached	Other[2]	Total	Unbleached	Other[2]
1989	125	97	28	874	772	102	1,913	1,658	255	472	302	170
1988	105	81	24	973	863	110	1,946	1,684	262	594	479	115
1987	112	88	24	883	785	98	2,023	1,769	254	538	431	107
1986	117	93	24	831	747	84	2,314	2,050	264	526	412	114
1985	124	93	31	876	796	80	2,386	2,120	266	576	398	178
1984	135	97	38	968	878	90	2,543	2,284	259	591	405	186
1983	147	101	46	967	879	88	2,529	2,289	240	606	397	209
1982	138	93	45	973	895	78	2,433	2,211	222	547	364	183
1981	183	103	80	1,085	967	118	2,188	2,012	176	516	340	176
1980	240	137	103	1,154	1,062	92	2,330	2,101	229	670	419	251
1979	306	187	119	1,212	1,110	102	2,365	2,115	250	786	499	287
1978	365	210	155	1,111	1,019	92	2,365	2,092	273	815	551	264
1977	354	218	136	1,180	1,073	107	2,516	2,212	304	794	558	236
1976	321	195	126	1,228	1,100	128	2,428	2,154	274	902	499	403
1975	280	165	115	974	879	95	2,166	1,938	228	752	417	335
1974	369	226	143	1,409	1,279	130	2,134	1,889	245	980	535	445
1973	425	267	158	1,176	1,072	104	2,196	1,942	254	1,057	599	458
1972	498	294	204	1,101	996	105	2,183	1,942	241	1,142	694	448
1971	491	285	206	1,078	976	102	2,146	1,911	235	1,084	591	493
1970	518	298	220	1,094	996	98	2,117	1,898	219	1,088	596	492
1969	574	345	229	1,123	1,023	100	2,018	1,791	227	1,146	621	525

1. Excludes glassine, greaseproof, and parchment papers and specialty industrial papers.
2. Principally bleached kraft papers.
Source: Bureau of the Census (1981-89 based on shipments; prior years are for production).

tegrated producer of grocery sacks (after Stone Container) with the ability to serve markets in the eastern U.S.

Shipping sacks are the second-largest end use for unbleached kraft paper after grocery bags and sacks. Shipments peaked at 1.0 million tpy in 1981. They averaged about 880,000 tpy in the 1982-84 period and plummeted to 747,000 tons in 1986. In 1987, shipments rebounded to 785,000 tons. They increased further to 840,000 tons in 1988 but slipped to 772,000 tons in 1989. Shipments of bleached multiwall sack paper climbed from 98,000 tons in 1987 to 110,000 tons in 1988 and then slipped to 102,000 tons in 1989. Total multiwall paper shipments were expected to drop off again in 1990 because of weaker demand for shipping sacks from agricultural, chemical, and construction industries.

Multiwall paper shipments were up sharply in 1987 and 1988 because of strength in those industries where multiwall sacks are used for shipping fertilizer, animal feed, seed, cement, plastic resins, and other materials. The major competitive threat to shipping sacks is from bulk handling and heavy-duty plastic shipping sacks, which have penetrated about 10% of the U.S. market. Many multiwall sacks, however, already have a single barrier layer of polyethylene for moisture resistance and added strength.

A more significant reason for the decline in multiwall paper tonnage since 1981 is the reduction in the weight of paper used in multiwall sacks. The four basic weights of

U.S. EXPORT AND IMPORT TRENDS FOR PACKAGING AND INDUSTRIAL CONVERTING PAPERS

(000 short tons)

Year	Exports[1]	Imports
1989	342	407
1988	347	343
1987	294	310
1986	284	243
1985	244	172
1984	284	145
1983	261	108
1982	263	80
1981	303	94
1980	331	86
1979	227	143
1978	173	138
1976	356	56
1974	340	142
1972	183	148
1970	188	64

1. Includes special industrial paper and glassine, greaseproof, and parchment.

Sources: American Paper Institute, Bureau of the Census.

U.S. PRODUCTION OF UNBLEACHED KRAFT PACKAGING AND INDUSTRIAL CONVERTING PAPERS

(000 short tons)

				Bag and sack[2]			Other converting[3]				
Year	Total	Wrapping[1]	Shipping sack	Total	Grocer	Other	Total	Asphalting	Other creping	Gumming	Other
1989	2,958	90	775	1,658	1,595	63	435	—	—	—	—
1988	3,107	81	863	1,684	1,610	74	479	—	—	—	—
1987	3,073	88	785	1,769	1,690	79	431	—	—	—	—
1986	3,302	93	747	2,050	1,960	90	412	—	—	—	—
1985	3,403	93	797	2,116	2,043	73	397	—	—	—	—
1984	3,683	97	883	2,292	2,203	89	411	—	—	—	—
1983	3,666	100	879	2,289	2,196	93	398	—	—	—	—
1982	3,563	93	895	2,211	2,127	84	364	—	—	—	—
1981	3,729	103	1,015	2,209	2,117	92	402	—	—	—	—
1980	3,852	137	1,062	2,269	2,168	101	384	176	40	63	105
1979	3,984	187	1,110	2,226	2,120	106	461	215	25	80	141
1978	3,900	211	1,019	2,225	2,121	104	445	173	22	61	189
1977	3,916	218	1,073	2,100	1,994	106	525	179	14	66	266
1976	3,815	195	1,100	2,106	1,966	140	414	167	6	68	173
1975	3,322	165	879	1,925	1,805	120	353	131	6	61	155
1974	4,079	226	1,279	2,131	1,974	156	443	134	13	83	213
1973	3,771	266	1,072	1,942	1,825	117	491	150	17	90	234
1972	3,825	294	996	1,942	1,854	88	593	165	25	96	307

1. All colored or natural brown MF and MG, including treated and untreated butcher papers.
2. Other than shipping sacks.
3. Data not available or withheld for 1981-89.

Sources: Bureau of the Census, American Paper Institute.

U.S. PRICE TRENDS FOR SELECTED UNBLEACHED KRAFT PAPER GRADES

($/short ton)

Year[1]	Shipping sack +50-lb	Grocery sack +70-lb	Grocery bag and sack +30-lb
1990			
2Q	$550	$495/500	$630/660
1Q	550	495/500	630/660
1989			
4Q	550	495/500	630/660
3Q	550/560	495/505	645/665
2Q	550/560	495/505	645/665
1Q	550/560	495/505	660/680
1988			
4Q	510/520	455/465	620/640
3Q	510/520	455/465	620/640
2Q	510/520	455/465	620/640
1Q	510/520	455/465	620/640
1987			
4Q	480/490	425/435	590/610
3Q	450/460	400/405	570/580
2Q	455	400	565
1Q	455	400	565
1986	390	335/345	535
1985	375	288	441
1984	415	336	502
1983	395	250	—
1982	381	260	—
1981	401	305	—
1980	371	272	—
1979	328	243	—
1978	296	220	—
1977	288	199	—
1976	271	209	—
1975	266	220	—
1974	220	199	—

1. Annual average showed for years 1974 to 1986.
Source: *Pulp & Paper Week.*

kraft paper—40, 50, 60, and 70 lb—have different tear and tensile strengths. It is a general rule that greater weight means greater strength. But tear and tensile properties of kraft paper have improved during the last decade, permitting substitution of lighter-weight paper. For example, during the drying process, the MD strength of kraft paper can be substantially increased by compacting the sheet or by allowing the sheet to shrink during the drying process. This extensible kraft paper can absorb more shock without rupturing than can conventional kraft paper and was commercially developed in the late 1950s by Clupak Inc.

Clupak Inc. in New York is the leading licensor of extensible kraft paper technology throughout the world. In 1982, St. Regis Paper Co. introduced a rival air-dried multiwall kraft paper with greater strength and stretch. This Stress Kraft paper permitted sack converters to eliminate a ply of paper for a basis-weight reduction of at least 18%, yet it performed as well as regular sack. Nevertheless, converters were unwilling to pay a premium price for Stress Kraft, and orders dried up during the country's economic downturn. Following Champion's takeover of St. Regis in 1984, production of Stress Kraft was phased out on the 240,000-tpy paper machine at Pensacola, Fla., by early 1986.

Prices for 50-lb multiwall kraft paper increased about 11% in 1986 and 14% in 1987. During the second quarter of 1988, they reached $510 to $520/ton In 1989, they climbed to between $550 and $560/ton and remained near the $550/ton level in 1990. Higher prices were paid for clay-coated or bleached multiwall paper. The price of 50-lb clay-coated bleached multiwall paper used in high-quality printed bags reached $1,240 to $1,280/ton in 1989.

The long-term outlook for shipping sack paper shipments is more encouraging than it is for grocery bags and sacks. Total bleached and unbleached paper shipments increased about 6% in 1987 and 7% in 1988. Shipments declined in 1989, owing to market weakness and significant inventory reductions. However, long-term growth will average between 1% and 2% annually.

Other bag and sack paper is used mainly for retail bags for bakery products, fast-food chains, and department stores. Losses in these markets appear to have bottomed out. Paper garment bags were largely displaced by plastics in the 1960s, and merchandise bags met heavy competition from plastics in the 1970s. With the introduction of low-cost, HDPE resins, plastic merchandise bags captured an estimated 75% of the market. However, a consumer backlash has recently developed against plastic bags that are not biodegradable or recyclable.

Paper suppliers have not yet given up on these markets that

MAJOR U.S. UNBLEACHED KRAFT PAPER CAPACITY WITHDRAWALS

Completed	Mill	Capacity (short tpy)	Date
Gulf States Paper	Tuscaloosa, Ala.	167,000	1978
Crown Zellerbach	Bogalusa, La.	140,000	1979
Boise Southern	Elizabeth, La.	105,000	1981
Manville Forest	West Monroe, La.	35,000	1981
St. Regis	Lufkin, Texas	100,000	1981
Georgia-Pacific	Crossett, Ark.	175,000	1984-85
	Monticello, Miss.	158,000	1985
International Paper	Mobile, Ala.	135,000	1985
Champion International	Pensacola, Fla.	236,000	1986
Gilman Paper	St. Marys, Ga.	86,000	1988
Total withdrawals		**1,337,000**	

typically use lightweight kraft papers. Longview Fibre Co., a large supplier of lightweight kraft packaging papers, plans to install a new 300-tpd lightweight bag and specialty kraft paper machine at its Longview, Wash., kraft mill. Scheduled for startup in late 1990, the $90-million project will permit Longview to produce a variety of lightweight grades that are in strong demand for bags and sacks, specialty packaging applications, and labels and release papers.

In 1989-90, lightweight 30-lb unbleached kraft bag paper sold for about $660/ton in the U.S. Lightweight 30-lb bleached kraft bag paper sold for between $800 and $810/ton in 1989-90.

Demand has also been strong for the MF and MG papers that are used to produce specialty merchandise bags. Upscale department stores typically use heavier-weight, decorative paper merchandise bags to convey a quality image, and retail food stores often use lighter-weight, bleached coated paper bags for their sanitary appearance.

Wrapping paper also has lost much of its market share to plastic stretch and shrink films. Shipments of unbleached and bleached wrapping papers total about 100,000 tons annually. For the short term, demand is not expected to slip significantly, since most of the displacement has already occurred. Unbleached grades are used mostly for parcel post and industrial shipping, while the bleached grades are used mostly as butcher paper.

Other kraft converting papers, both unbleached and bleached, account for about 260,000 tons annually, and specialty packaging grades account for approximately 600,000 tpy. These grades were most affected by API's reclassification of specialty packaging and industrial grades. They are usually coated, waxed, gummed, or laminated for use as food liners, label face stock, and release liner basestock, among other applications.

The Consolidated Papers Inc. mill at Stevens Point, Wis., is the largest producer of these lightweight coated specialty grades. The mill's two machines produced about 56,000 tons in 1988, and the company is spending $110 million to install a new 160-tpd fourdrinier-type machine, with completion scheduled for late 1990.

Although demand for these papers declined in the 1970s as plastics claimed a large share of the flexible packaging market, the erosion has slackened in recent years. Convert-

U.S. PRODUCTION OF MAINLY BLEACHED PACKAGING AND INDUSTRIAL CONVERTING PAPERS[1]

(000 short tons)

			Shipping sack[3]			Other bag and sack			Other converting[4]		
Year	Total[1]	Wrapping[2]	Total	Sulfite kraft	Other	Total	Grocer	Other	Total	Waxing	Other[5]
1989	636	48	184	174	10	234	169	65	170	110	60
1988	674	46	190	182	8	242	172	70	196	128	68
1987	663	46	178	168	10	214	153	61	225	147	78
1986	616	33	173	162	11	204	142	63	205	148	57
1985	570	33	118	107	11	240	170	70	178	130	48
1984	555	50	113	92	21	209	137	72	183	132	51
1983	561	65	119	95	24	168	122	46	209	157	52
1982	497	66	105	—	—	143	105	38	183	136	47
1981	536	80	117	84	34	176	124	51	167	120	47
1980	574	103	92	—	—	229	155	73	150	98	52
1979	643	119	102	—	—	250	170	80	172	113	59
1978	711	155	92	—	—	273	217	55	191	76	115
1977	716	136	107	—	—	304	198	106	169	69	100
1976	852	126	128	29	99	274	153	121	324	117	207
1975	629	115	95	27	68	228	133	95	191	97	94
1974	774	143	130	39	91	245	144	101	256	117	139
1973	786	158	104	22	82	254	169	85	270	138	132
1972	849	204	115	23	92	241	168	73	289	141	148

1. Excluding unbleached, glassine, greaseproof, and parchment papers. Principally bleached kraft paper, but can include sulfite and other-fiber-based papers.
2. Includes MG and MF wrapping papers and miscellaneous. MG/MF includes treated and untreated butcher papers.
MG/MF production: 1980, 95; 1979, 109; 1978, 127; 1977, 122; 1976, 109; 1975, 100; 1974, 121; 1973, 133; 1972, 171:
Miscellaneous production: 1980, 8; 1979, 10; 1978, 28; 1977, 15; 1976, 17; 1975, 15; 1974, 22; 1973, 25; 1972, 33.
3. Includes combination kraft and rope, bleached and semibleached.
4. Over 18 lb. Production figures available in earlier years:
Envelope stock: 1976, 130; 1975, 99; 1974, 135; 1973, 130; 1972, 126.
Gumming stock: 1980, 32; 1979, 34; 1978, 23; 1977, 14; 1976, 12; 1975, 10; 1974, 11; 1973, 13; 1972, 13.
Twisting/spinning stock: 1974, 34; 1973, 35; 1972, 48.
5. Such as asphalting, creping stock, etc.
Sources: Bureau of the Census, *Pulp & Paper* estimates.

ed grades in direct competition with plastic films will continue to lose share gradually, but demand from other areas will support growth in specialty papers.

SPECIALTY INDUSTRIAL PAPERS

Specialty industrial papers represent a unique segment of the paper industry. More than 300 different specialty papers are produced for industrial customers in the U.S. and abroad. These papers are generally used by industry for conversion into other products, and they require the blending of various fibers and chemicals and special surface treatment or lamination with synthetic films, textiles, or other materials. Often produced to exact customer specifications, industrial papers are used in the manufacture of automotive oil and air filters, cigarette papers, sanding belts and other abrasives, masking tapes, engine gaskets, electrical insulators, and pressure-sensitive release papers.

Production of specialty industrial papers has increased gradually since 1970 and currently totals about 1.186 million tons, according to API. However, because it is difficult to define these grades and to separate them from other converting grades, published capacity and production figures are not good indicators of industry trends. Some types of industrial papers have lost market share, especially in areas where plastic and synthetic products can substitute, such as nonwovens. Nonetheless, overall demand for specialty grades continues to expand, with pressure-sensitive release papers and filter papers performing best. In turn, pricing for most specialty grades remains strong. Some specialty paper sells for as high as $8/lb (or $16,000/ton) in the U.S.

Specialty papers typically are produced by small, privately held companies or specialty papers divisions of larger paper companies, and mills usually have capacities ranging from 12 to 50 tpd. Most of these mills purchase pulp from outside sources and may need as many as 10 to 20 different types of woodpulp, glass fibers, hemp fibers, and other materials to produce specialty papers. A mill often produces up to eight different grades of specialty paper per day on older machines with widths of 15 ft or less.

James River is by far the major North American producer of specialty industrial papers. Other notable producers include Filtration Sciences,

AVERAGE VALUE OF U.S. EXPORTS AND IMPORTS FOR PARCHMENT, GREASEPROOF PAPERS, AND GLASSINE

($/short ton)

Year	Exports	Imports
1988	$1,148	$1,551
1987	2,188	1,487
1986	2,385	1,374
1985	1,551	1,390
1984	1,625	1,416
1983	1,067	1,453
1982	1,330	1,498
1981	1,187	1,686
1980	1,148	1,578
1979	1,008	1,020
1978	833	948
1977	807	879
1976	739	849
1975	445	872
1974	655	731
1973	651	616

Source: Dept. of Commerce.

PRODUCERS OF VEGETABLE PARCHMENT, GLASSINE, AND GREASEPROOF PAPERS

Company	Location	Grades	Capacity[1] (tpd)
1. James River Corp.			
Riegel Products Div.	Milford, N.J.	Glassine, greaseproof	100
KVP/Dunn Paper Div.	Parchment, Mich.	Vegetable parchment	120
2. Wausau Paper Mills Co.			
Rhinelander Paper Co.	Rhinelander, Wis.	Glassine, greaseproof	150
3. Hammermill Paper Co.			
Nicolet Paper Co.	De Pere, Wis.	Glassine, greaseproof	140
4. E.B. Eddy Forest Products	Espanola, Ont.	Vegetable parchment, greaseproof	140
5. Flexel Inc.	Atlanta, Ga.	Cellophane	114
6. Simkins Industries			
Westfield River Paper Co.	Lee, Mass.	Glassine, greaseproof	15
	Russell, Mass.	Glassine, greaseproof	50
Deerfield Specialty	Nixon, Ga.	Glassine, greaseproof	55
	Quebec, Que.[2]	Glassine, greaseproof	35
7. Domtar Inc.	St. Catherines, Ont.	Glassine, greaseproof, vegetable parchment	70

1. Capacity estimates may include tonnage of other specialty grades.
2. Subsidiary is Glassine Canada Inc.

C.H. Dexter, Mosinee Paper, Hollingsworth & Vose, Wausau Paper Mills, P.H. Glatfelter, CPM, Thilmany Pulp & Paper, and Georgia-Pacific. In 1989, European specialty papermaker A. Ahlstrom Corp. acquired Filtration Sciences, the leading U.S. manufacturer of automotive filter papers. Also in 1989, the Kapaco Group acquired specialty papermaker Watervliet Paper Co.; James River acquired the Wyomissing specialty paper division of Paper Corp. of America; and Mead Corp. sold its silicone-coated release liners business to Rexham Industries Inc. In 1988, Portals Papermaking Ltd. sold its Hawkinsville, Ga., paper mill to Hollingsworth & Vose.

Specialty decorative laminating papers are a unique, growing segment of the specialty industrial area. These papers are combined with either particle board or saturating kraft paper to produce laminates for kitchen countertops, office furniture, or construction grades. The decor papers are produced by the specialty paper divisions of Mead Corp., Rolland Inc., and Sorg Paper Co. Industry capacity of decor papers is estimated at about 60,000 tons.

The major producers of saturating kraft papers are Westvaco Corp., Charleston, S.C.; Union Camp Corp., Savannah, Ga.; and Simpson Tacoma Kraft Co., Tacoma, Wash. In 1984, Union Camp completed a $27-million improvement on its saturating kraft paper machine, and in 1987, Westvaco rebuilt a saturating kraft paper machine to increase capacity. In 1989, Simpson installed the world's largest converting unit for impregnating kraft papers with phenolic resins. Ivex Corp. also produces waterproof saturated papers at its Joliet, Ill., mill. Industry capacity of saturating kraft papers is estimated at about 350,000 tons.

GLASSINE/VEGETABLE PARCHMENT/GREASE-PROOF

Glassine papers have smooth, glasslike surfaces and are transparent. They are used mostly for protective food and nonfood packaging, but other applications include drafting and graphic papers and envelope windows. Glassine typically is produced from sulfite pulp.

Sulfite pulp is beaten and refined to such a high degree that the pulp appears to be a dense, gelatinous mass. The high degree of fiber damage and collapse that occurs during pulping increases the fiber bonding area and makes glassine highly resistant to the passage of vapors, oils, and grease. When waxed, lacquered, or laminated, the paper is also impervious to moisture. Glassine is formed on a fourdrinier paper machine and is supercalendered to give the sheet a high gloss. Typical basis weights range from 15 to 40 lb (24 x 36 in., 500 sheets).

Vegetable parchment gets its name from its physical similarity to animal parchment. It is prepared by passing a sheet of cotton-fiber or chemical-woodpulp paper through a bath of sulfuric acid, followed by washing and drying. The resulting sheet has a "parchment" feel and appearance, and it is very durable and resistant to grease and other contaminants. The sheet has high wet strength, and it may be waxed, coated, embossed, or crinkled. As a printing paper, it is a high-quality sheet used for legal documents. Basis weights range from 24 to 40 lb. (17 x 22 in., 500 sheets).

For packaging purposes, vegetable parchment and grease-proof papers have various weights and degrees of translucency or opaqueness. They are used to wrap frozen, moist, greasy, or dry food products such as butter, meat, and poultry. Like cellophane and waxed papers, they have lost many of their traditional markets to plastic films. In 1980, production of these papers was reported by the Bureau of the Census to be about 200,000 tons. The figure may be half of that amount today. James River, Nicolet Paper Co., and Simkins Industries Inc. in the U.S. and E.B. Eddy Forest Products Ltd. in Canada are the industry's remaining principal producers. Flexel Inc., Atlanta, Ga., is the only U.S. producer of cellophane.

CANADIAN KRAFT PAPER INDUSTRY

The Canadian kraft paper industry has many of the same market conditions for its products as the U.S. industry. Domestic kraft paper consumption has gradually declined as plastic products have replaced paper bags and sacks in traditional end-use markets. However, Canadian producers

ESTIMATED CAPACITY OF CANADIAN COMPANIES FOR KRAFT AND SPECIALTY PAPERS

(000 metric tons)

Company	Annual capacity*	Grades
Repap Manitoba[1]	140	Unbleached bag, sack
Eurocan Pulp & Paper Co.	130	Unbleached bag, sack, wrapping
Prince George Pulp & Paper[2]	110	Bleached and unbleached sack, bag
Cascades Inc.	80	Unbleached and bleached bag, wrapping
Fletcher Challenge Canada Ltd.[3]	45	Bag, wrapping, converting
E.B. Eddy Forest Products Ltd.	45	Bleached bag, sack, converting, wrapping
Domtar Inc.	30	Bleached and unbleached bag, sack, converting, wrapping
Fraser Inc.	8	Kraft wrapping and specialty paper
J. Ford & Co. Ltd.	7	Kraft wrapping and specialty paper

* Consolidated-Bathurst shut down a 35,000-metric-tpy kraft paper machine in 1988.

[1] Formerly Manfor Corp.

[2] Subsidiary of Canadian Forest Products Ltd.

[3] Formerly Crown Forest Industries Ltd.

have offset these losses by increasing their export shipments of kraft paper to the U.S. and overseas markets, particularly for high-strength shipping sack grades.

Production of bleached and unbleached kraft papers gradually declined from a cyclical peak of 637,000 metric tons in 1978 to 430,000 tons in 1984. By 1988, production had rebounded to 568,000 tons but slipped to 525,000 tons in 1989. Operating rates also improved from a low of 77.4% in 1984 to a strong 95.8% in 1988 and 98.9% in 1989.

The decline in domestic consumption of kraft papers has affected mostly eastern Canadian mills, which were built to serve the domestic market and are not particularly cost-competitive. Companies that have dropped out of the kraft paper business were concentrated in the east and include Great Lakes Forest Products Ltd., CIP Inc., Abitibi-Price Co., and Consolidated-Bathhurst Inc. The western Canadian industry, on the other hand, is highly export-oriented and includes large, efficient mills operated by Canfor Corp., Eurocan Pulp & Paper Co. Ltd., and Manfor Ltd. All these companies have constructed new mills during the past ten years with capacities in excess of 100,000 metric tpy.

In 1989, the most significant development in this sector was the sale of Manfor Ltd., formerly owned by the Manitoba government, to Repap Enterprises Inc. Repap plans to convert the kraft mill's production from 400 metric tpd of high-strength kraft sack paper to 500 metric tpd of bleached kraft pulp. In a second stage, Repap plans to construct a world-class, 1,200 metric-tpd softwood bleached kraft pulp mill at the facility.

Domestic paper shipments have declined from about 240,000 metric tpy to 187,000 tpy in the past three years. Plastics have captured about 60% of the Canadian grocery bag and sack market and about 40% of the shipping sack market. Although this market penetration is uneven throughout the country, it is generally conceded that market losses will continue, although at a slower rate.

Exports of kraft paper have increased steadily from about 192,000 metric tons in 1984 to 330,000 metric tons in 1989. Approximately 50% of kraft paper exports are destined for the U.S. market, and nearly 100% of converted kraft paper bag and sack exports go to the U.S. Multiwall kraft paper and shipping sacks account for most of the export activity.

U.S. PRODUCTION, EXPORTS, AND IMPORTS OF PARCHMENT, GREASEPROOF PAPERS, AND GLASSINE

(000 short tons)

Year	Production	Exports	Imports
1988	—	32	24
1987	—	6	23
1986	—	4	17
1985	—	6	16
1984	—	5	12
1983	209	17	8
1982	206	5	6
1981	176	9	5
1980	202	8	4
1979	234	8	5
1978	259	8	5
1977	219	5	3
1976	207	10	3
1975	191	11	2
1974	240	8	3
1973	230	4	3
1972	234	3	2
1971	206	3	2
1970	203	3	3
1969	216	—	—

Source: Bureau of the Census.

CANADIAN PRODUCTION AND CAPACITY FOR KRAFT PAPERS

(000 metric tons)

Year	Production	Capacity	Utilization rate (%)
1989	525	531	98.8%
1988	568	584	97.3
1987	567	586	96.7
1986	540	579	93.3
1985	486	541	89.8
1984	430	531	81.0
1983	475	554	85.7
1982	453	527	86.0
1981	516	566	91.2
1980	538	562	95.7
1979	606	617	98.2
1978	637	622	102.4
1977	546	621	87.9
1976	518	624	83.0
1975	422	641	65.8
1974	637	636	100.2
1973	616	602	102.3
1972	537	570	94.2
1971	492	—	—
1970	439	—	—
1969	451	—	—

Source: Canadian Pulp & Paper Assn.

Paper:

TISSUE

Tissue falls into two broad categories: sanitary and other. Sanitary products predominate and include bathroom, facial, toweling, napkins, basestock for sanitary stock, wadding, and wipes. The "other" group, a mere 2% of the market, covers basestock for waxing, wrapping, and miscellaneous uses.

The two major outlets for tissue are consumer and commercial and industrial (C&I). Through 1993, consumer growth will be 1% to 2% per year vs 3.5% to 4% for commercial products. Consumer tissue accounts for 62% of the market and is purchased at retail outlets. Industrial tissue goes to hotels, offices, restaurants, factories, and institutions.

When the economy slows, consumers turn to lower-price tissue, hurting upscale producers. Private-label products also do better. And people eat out less in an economic dip, dampening the demand for C&I tissue.

Currently, consumers favor branded tissue over private-label and generic tissue by a ratio of 4:1, according to Jeanne Carroll, an analyst at Morgan Stanley. And premium products' share of the branded sales plummeted from 77% in 1979 to 55% in 1989.

On the whole, the tissue business is relatively noncyclical and shows fairly steady historical growth rates between 2% and 2.5% per year. The last couple of years have been active, with shipments growing 3.6% in 1988 and 4.5% in 1989, according to Morgan Stanley's estimates. But shipment growth is expected to slow to 2% this year, then recover to 2.5% by 1993.

Tissue capacity rose 1.8% per year from 1983 to 1988, and Morgan Stanley expects that rate to hit 3.4% in the period from 1989 to 1993. Operating rates have bounced around between a low near 87% in 1982 and a record high of 98% in 1989. Morgan Stanley projects a fairly steady drop to 93% in 1993.

According to American Paper Institute figures, U.S. tissue production rose 2.9% to 5.64 million tons last year. Industry capacity in 1989 was 5.76 million tons, so operating rates were up around 98%. That beat out 1988 operating rates of 97%, when production stood at 5.48 million tons.

Tissue firms' profits are expected to hit 14% in 1990 and 16% in 1991, Carroll said—a healthy jump from a showing of less than 1% in 1988 and 11% in 1989, when profits were squeezed by raw material costs. Market pulp prices have been an especially touchy subject for tissue producers, more than doubling from third-quarter 1985 to $753/ton in third-quarter 1989. Secondary fiber subsequently became more popular, Carroll noted, because it is usually $200 to $300/ton cheaper than market pulp. But pulp prices are declining, and wastepaper tabs should follow.

Tissue prices rose 4.2% in the consumer sector and 5% in the commercial sector last year. Morgan Stanley expects prices to go up just 2.5% to 3% in 1990 and 1991. Cuts in sheet counts have also increased margins to some extent.

U.S. STATISTICS FOR TISSUE

	1990e	1989	1988
Production, 000 tons*	5,725	5,636	5,476
Capacity[1]	5,972	5,762	5,667
Utilization rate, %	95.9	97.8	96.6
Imports[2]	108	121	60
Exports[2]	35	21	41
Apparent U.S. consumption	5,798	5,736	5,495
lb/capita	46.3	46.2	44.7
GNP ratio (000 tons*/ billion $ real GNP)	1.37	1.38	1.37

e = Estimate.
* All tons are short tons.
1. American Paper Institute data.
2. U.S. Dept. of Commerce data.

Since 1983, premium bathroom tissue rolls have shrunk 30% to 300 sheets; towels also were reduced 30%, to 80 sheets.

Early in 1989, at a time when tissue mills were running at 98% of capacity, Procter & Gamble Co. bumped up consumer bathroom tissue tabs 9.8% east of the Rocky Mountains and 8.0% west of that barrier. Scott Paper Co. went after a 6% to 8% rise on C&I napkins effective Feb. 1989.

By mid-1989, discounts offered by some C&I tissue producers in the Northeast had erased the 7% price increase instituted the previous fall. These declines affected many napkins and towels and some toilet paper. The Midwest and West Coast markets were weak. Scott, on the other hand, raised some toilet tissue tabs an additional 6%. And in the consumer market, Scott managed to gain a 6.5% increase on its value-brand ScotTissue bathroom tissue.

Fort Howard Corp. led a 5% to 7% hike on C&I towels, toilet paper, napkins, and facial tissue in October 1989 and was well supported by competitors. The firm was reportedly running flat out and took the action to avoid major backups on orders. Another plus, the company could use the extra money to fund three new tissue machines due within five years and to pay off debt from its leveraged buyout in 1988.

Merchants were puzzled by the cost increase and warned that the market was growing weak even before the price change was attempted. Nevertheless, the increase on toilet tissue went through in the Northeast, driven by Scott's tight capacity and machine problems at James River Corp.'s mills in Maine and New York. The towel hike was not as successful in the region, though all increases in the Midwest and the West Coast held.

Consumer bathroom tissue producers sought a hike early in 1990, led by James River's 5.7% increase on its national brands effective Feb. 19. The hot pulp market was leveling off at the time, raising doubts that James River could carry off the move.

But P&G and Scott rallied behind James River. P&G upped tabs 5.6% on Charmin and White Cloud starting in March 1990, and Scott pushed up premium bath tissue and napkins 5.5%.

At the same time, the industrial tissue market continued

U.S. SHIPMENTS AND CAPACITY OF TISSUE PAPER

(000 short tons)

Year	Production[1]	Change (%)	Capacity[2]	Change (%)
1992p	—	—	6,203	1.2%
1991p	5,825	1.7%	6,127	2.6
1990p	5,725	1.6	5,972	3.6
1989	5,636	2.9	5,762	1.7
1988	5,476	3.3	5,667	2.9
1987	5,301	4.0	5,505	0.6
1986	5,095	3.1	5,472	2.4
1985	4,941	0.4	5,345	1.3
1984	4,921	2.7	5,276	1.7
1983	4,792	7.9	5,190	1.3
1982	4,441	-1.7	5,125	1.8
1981	4,517	3.2	5,033	1.6
1980	4,375	-3.2	4,954	1.7
1979	4,521	7.3	4,870	4.8
1978	4,215	-1.6	4,644	2.1
1977	4,285	2.4	4,545	1.0
1976	4,184	5.2	4,500	1.5
1975	3,979	-2.6	4,432	2.5
1974	4,086	1.2	4,322	0.4
1973	4,039	1.6	4,303	-0.3
1972	3,977	3.8	4,318	1.7
1971	3,833	3.1	4,244	1.4
1970	3,718	3.0	4,185	8.1
1969	3,611	—	3,873	—
Average 1979-89		2.7		2.0

p = Preliminary.

1. Source: Bureau of the Census.

2. Source: American Paper Institute.

CANADIAN PRODUCTION AND CAPACITY FOR TISSUE AND SANITARY PAPERS

(000 short tons)

Year	Production[1]	Capacity Sanitary papers	Capacity Other tissue
1992e	—	734	20
1991e	—	712	20
1990e	—	660	20
1989	493	559	20
1988	494	548	20
1987	466	535	21
1986	495	516	20
1985	476	509	20
1984	424	514	20
1983	411	495	20
1982	413	500	21
1981	430	474	21
1980	406	414	23
1979	399	401	23
1978	368	403	24
1977	342	404	22
1976	335	385	25
1975	283	372	28
1974	361	353	27
1973	324	349	23
1972	312	344	20
1971	289	—	—
1970	240	—	—
1969	281	—	—

e = Estimate.

1. Excludes special papers.

Source: Canadian Pulp & Paper Assn.

to weaken, and discounting was expected. Kimberly-Clark Corp. announced early in 1990 a 4.5% hike on facial tissue effective in second-quarter 1990.

The tissue business is fairly concentrated, with the top six producers holding 85% of the market. Scott weighed in with 19.5% of the business in 1989, according to Morgan Stanley, followed closely by James River with 18.8%. Fort Howard showed a 16.1% share, and P&G had 13.8%.

Scott and P&G each account for a quarter of the consumer business, followed by James River. Morgan Stanley noted that Fort Howard holds one-fourth of the market in the commercial sector, and James River comes in second with one-fifth.

Bathroom tissue accounts for half of the consumer market, towels represent about one-third, and facial tissue and napkins split the rest. In the commercial sector, towels dominate with half the business, napkins and bathroom tissue each hold about a quarter, and facial tissue holds a mere sliver of the market, Morgan Stanley reported.

P&G is the market leader in consumer bathroom tissue, according to analyst George Adler of Smith Barney, Harris Upham & Co. He pegs the firm's share of business at 29% to 31%, trailed by James River and Scott.

P&G introduced the one-ply value-brand Banner in 1982 to soak up excess capacity and to compete with Scott's value-brand ScotTissue. But the P&G product weakened in 1988, as did the firm's two-ply White Cloud, though Charmin boosted growth.

James River as a whole lost ground, ending up with 20.5% to 21.5% of the market. Adler attributed that to weakness in the company's Northern product, the second-largest brand after P&G's Charmin.

Scott showed a 22% share, with ScotTissue accounting for 12% of the market.

Georgia-Pacific Corp. dropped to 11% of the consumer bathroom tissue business, though the firm's Angel Soft brand, introduced in 1987, grew more than 4%.

Fort Howard, which leads the C&I sector, is now concentrating more attention on the consumer market and has carved out a 2% presence, Adler said.

Scott managed to pick up a 1% increase in towel business in 1988, ending up with 24%. Most of the growth was in the value-brand ScotTowel, which represents 14% of the market.

P&G's Bounty gained 0.5% to reach 21% in 1988. But James River dropped half a point to 14.5%. Although its Brawny product maintained position, Gala and Bolt—not available nationally—did not do too well.

In facial tissue, Kimberly-Clark is still on top with Kleenex, which dominates 40% to 45% of the market, Adler said. P&G's Puffs are a force to reckon with, having captured an 18% share. Scott's Scotties follow up with 12%.

The two principal players in napkins are James River and Scott, which pull in 23% and 22.5% of the business respectively. Adler noted that private-label and generic napkins represent 31% to 33% of the market.

Scott, which has focused two-thirds of its business on the consumer sector, is moving aggressively to maintain a strong share of the tissue market. It has good cause: growth in demand for Scott's tissue products has been twice that for the tissue market in general.

Early in 1989, Scott Paper Ltd., the Canadian affiliate of Scott Paper Co., picked up E.B. Eddy Forest Products Ltd.'s White Swan Tissue Div., based in Hull, Que. The C$110-million purchase brought Scott 222 metric tpd production of bathroom tissue, facial tissue, towels, napkins, and some wax paper.

Scott Paper Co. enjoyed its sixth consecutive year of record operating earnings in 1989. Earnings for the U.S. tissue sector rose 15% over 1988 results, although they crashed in Europe, down 20% to 30%. The firm blamed losses in the U.K. in part on consumer demand for recycled and chlorine-free products, which led to a 1% loss in market share there. The U.K. work force was thus the target of

U.S. SHIPMENTS OF TISSUE PAPER, EXCLUDING SANITARY AND THIN PAPER

(000 short tons)

Year	Total tissue paper[1]	Wrapping tissue	Waxing tissue stock	Twisting tissue stock	Creped wadding[2]	Other tissue paper
1989	160	77	(D)	—	(D)	33
1988	163	77	(D)	—	(D)	36
1987	145	69	(D)	—	(D)	28
1986	130	59	(D)	—	(D)	23
1985	126	56	(D)	—	(D)	23
1984	136	69	(D)	—	(D)	31
1983	110	(D)	(D)	—	(D)	20
1982	106	(D)	(D)	—	(D)	21
1981	114	(D)	(D)	—	(D)	25
1980	176	72	24	13	25	18
1979	198	63	31	14	41	21
1978	210	74	32	12	37	29
1977	197	74	28	9	35	28
1976	193	61	37	8	30	30
1975	178	47	39	7	34	22
1974	224	44	49	10	46	41

(D) = Data withheld to avoid disclosing figures for individual companies.

1. Excluding sanitary and thin.

2. Creped wadding for interior padding.

Source: Bureau of the Census.

a reduction early in 1990 to increase competitiveness.

Scott will be spending $30 million to rebuild an idle machine at its Chester, Pa., mill. This, along with a new $200-million mill on the Ohio River in Indiana or Kentucky, should release Scott from the need to buy tissue paper.

Construction on the Ohio River project should begin in 1991. Products will be based on more than 20% recycled fiber content; output will be aimed at consumer and/or commercial sectors.

Scott and other producers are paying increasing attention to non-U.S. markets. Morgan Stanley estimates the European tissue market is expanding at 4.5% to 5%—twice the growth of the U.S. sector. The Pacific region is also going strong.

Scott dominates the Western European tissue scene, with year-end 1989 capacity of 605,000 short tons, or 15% of the market. Morgan Stanley expects the firm's Western European capacity to reach 715,000 short tons by 1992. Investments will total $250 million in Europe and $50 million in the Pacific.

Scott's 50,000-tpy tissue machine at its new mill in Orleans, France, and another 50,000-tpy tissue machine in Alanno, Italy, were due online in 1990.

James River also has extended its borders, linking up with the Nokia Group of Finland and Montedison to form a "pan-European tissue and related hygienics products group." The agreement spawned a unit with annual sales expected to total $1.3 billion and tissue capacity of 495,000 metric tpy. The three parents are reportedly aiming at the largest market share of European tissue and plan to spend $1.5 billion on investments to achieve that goal within five years.

In addition, James River and Gruppo Ferruzzi of Italy bought the tissue operations of Bührmann-Tetterode of the Netherlands. The unit had 1988 sales of $95 million.

Slightly more than half of James River's tissue business lies in the consumer sector, Carroll noted.

The firm announced a major restructuring in August 1990, involving divestiture of $1.3 billion in assets. James River planned to sell its towel and tissue mills in Glens Falls, N.Y., and Ashland, Wis. While that would cut capacity 140,000 tpy, other tissue commitments would hike overall tissue capacity by 200,000 tpy.

Fort Howard, which takes a 16% share of the U.S. tissue market, was responsible for a surprising 60% of the industry's capacity growth between 1983 and 1989, according to Morgan Stanley. That represented an investment of $800 million and a 73% capacity increase for the firm.

The expansions keep coming. Fort Howard expects a mid-1991 startup for a fourth tissue machine at its Savannah River mill in Rincon, Ga., raising the mill's 100% recycled tissue capacity 30%, or 225 tpd. Output will find its way primarily to the C&I market, where the firm has a 30% share.

Fort Howard apparently is the lowest-cost producer, with profit margins of 31%—compared with an industry

U.S. SHIPMENTS OF SANITARY TISSUE

(000 short tons)

Year	Total sanitary paper	Toilet tissue			Facial tissue	Napkin			Toweling[1]	Sanitary napkin wadding	Wiper stock[2]	Other sanitary stock
		Total	Single-ply	Multi-ply		Total	Single-ply	Multi-ply				
1989	5,291	2,097	1,156	941	332	699	519	180	1,858	(D)	156	150
1988	5,019	1,921	1,141	779	326	679	506	173	1,767	(D)	186	141
1987	4,740	1,798	1,077	721	301	623	432	194	1,715	(D)	178	122
1986	4,638	1,809	1,127	681	303	595	431	165	1,644	(D)	156	131
1985	4,494	1,833	1,198	635	302	596	451	144	1,521	(D)	111	131
1984	3,953	1,489	955	534	285	529	400	128	1,363	73	108	104
1983	4,337	1,742	941	802	292	594	467	127	1,449	99	60	99
1982	4,185	1,679	962	717	277	532	407	125	1,433	113	56	94
1981	3,917	1,533	944	588	298	474	341	133	1,253	116	129	114
1980	4,298	1,706	939	766	370	532	409	123	1,439	—	251	—
1979	4,403	1,772	978	794	376	533	404	129	1,482	86	240	—
1978	4,036	1,629	939	690	383	429	317	116	1,376	73	57	76
1977	4,045	1,605	877	729	365	370	353	117	1,388	73	48	96
1976	3,936	1,578	933	645	359	448	342	106	1,335	53	52	90
1975	3,669	1,422	828	594	374	436	334	102	1,230	69	62	89
1974	3,799	1,415	834	581	395	439	345	93	1,308	—	55	119

(D) = Data withheld to avoid disclosing figures for individual companies.

[1] Excludes wiper stock but includes facial tissue stock for towels.

[2] Regular, facial, and wadding type.

Source: Bureau of the Census, "Current Industrial Reports Series MA26A."

average of about 10%. Perhaps the firm's dependence on 100% recycled fiber plays a part in that performance.

Using recycled fiber in tissue was promoted by producers long before it caught on with consumers. Fort Howard actually tried to launch recycled tissue in the 1970s but did not meet with much enthusiasm. In 1989, Cascades Inc. became the first major North American producer to start selling "environmentally friendly" products, beginning with toilet tissue made without the use of chlorine. European and Scandinavian consumers were already enjoying such products.

And in February 1990, Fort Howard began promoting its 100%-recycled bathroom tissue and paper towels as environmentally friendly. The Green Forest Recycled Tissue product comes with a premium price tag, however, even though its quality compares with low-cost brands, such as Scott's ScotTissue.

P&G is completely concentrated on the consumer tissue sector. Disposable diapers are a strong outlet for the firm, which takes a 49% share of the market, Carroll said.

P&G's tissue and towel business has been growing significantly and nearing capacity, so the firm is pumping more than $100 million into an expansion project in the western U.S. At least one new paper machine will be built, and existing mills' output will also be increased. P&G is considering building a new West Coast plant or putting a new machine in its Oxnard, Calif., facility, which currently has one machine. Also in the cards is a $250-million investment in two new tissue machines at one of P&G's tissue mills east of the Rockies.

K-C is 80% concentrated in consumer products, according to Carroll, and holds just 10% of the consumer market. But in certain sectors, it has captured the lion's share. K-C said its consumer products' market share at year-end 1989 was 45% for facial tissue, 31% for diapers (including the number one brand Huggies), 30% for feminine pads, and 52% for incontinence care. The retail dollar incontinence market grew 18% in 1989 to about $200 million, and Morgan Stanley thinks it could triple by the mid-1990s.

In second-quarter 1989, K-C presented Huggies Pull-Ups disposable training pants—a step between diapers and underpants—and plans to go national with them in the first half of 1991. The firm thinks that market could be worth about $250 million.

The outlook for K-C's products is not uniformly bright, however. Unit sales of disposable diapers and facial tissue, which together account for nearly 40% of K-C's earnings, will likely grow only about 1%, Morgan Stanley warns.

The company has steered clear of new machines since 1968. But in 1989, it did start putting up a C&I tissue mill in Loudon, Tenn., which is due to go online in second-half 1990. The firm's Jenks, Okla., facility started up in midyear, producing 68,000 tpy of consumer tissue. K-C's two new U.S. tissue machines will add 80,000 tons of capacity, and three European ones will bring on 103,000 tons.

While bathroom tissue is K-C's number one consumer product outside the U.S., the sector was allowed to languish domestically. But now K-C is reviving its U.S. bath tissue business with a new premium one-ply product under the Kleenex brand name. The new tissue mill in Jenks gave the firm enough tissue capacity to re-enter the bathroom tissue market. The 100%-virgin-fiber tissue will first target southern and central U.S. markets.

NORTH AMERICAN TISSUE EXPANSIONS

Startup date	Company	Mill	Annual capacity (short tons)
1989	Vicell Canada	Delta, B.C.	9,900
1989	FSC Paper	Alsip, Ill.	70,000
1989	Atlas Paper Mills	Hialeah, Fla.	15,000
1989	Irving Pulp & Paper	St. John, N.B.	60,000
1989	Fort Howard	Rincon, Ga.	91,000
1990	Atlantic Packaging	Whitby, Ont.	30,000
1990	Kimberly-Clark	Loudon, Tenn.	n.a.
1990	Kimberly-Clark	Jenks, Okla.	75,000
1990	Cascades	Kingsey Falls, Que.	28,000
1990	Wisconsin Tissue	Menasha, Wis.	80,000
1990	Putney Paper	Putney, Vt.	5,000[1]
1990	Procter & Gamble	Green Bay, Wis.	n.a.
1991	Perkins Papers	Candiac, Que.	28,000
1991	Fort Howard	Rincon, Ga.	91,000
1991	Consumers Paper	Calgary, Alta.	28,000
1992	Potlatch	Lewiston, Idaho	39,000[2]
n.a.	Scott Paper	n.a.	n.a.[3]
n.a.	Procter & Gamble	n.a.	n.a.[4]
n.a.	Mosinee Paper	Middletown, Ohio	n.a.[5]
n.a.	James River	Old Town, Maine	80,000
n.a.	James River	Naheola, Ala.	80,000

n.a. = Not available.
1. Estimated capacity addition from rebuild.
2. Net capacity addition.
3. Scott Paper approved an expansion including a $200-million greenfield mill and rebuild of an idle machine.
4. Procter & Gamble plans an expansion valued in excess of $100 million, including at least one new machine in the West; $250 million will also be invested in two new machines in the East.
5. Mosinee Paper is putting $50 million into a new tissue operation.
Source: *Pulp & Paper Week*.

U.S. MARKET INDICATORS FOR TISSUE PRODUCTS

(billion units)

Year	Facial tissue (two-ply)	Disposable household towels (jumbo rolls)	Bathroom tissue (rolls)
1989	192	2.7	9.9
1988	196	2.6	9.6
1987	196	2.5	9.1
1986	194	2.4	8.7
1985	190	2.4	8.6
1984	191	2.3	8.1
1983	190	2.2	7.7
1982	188	1.9	6.9
1981	183	1.8	6.6
1980	179	1.8	6.7
1979	181	1.7	6.6
1978	181	1.6	6.5
1977	180	1.5	6.3
1976	182	1.5	5.8
1975	177	1.4	5.3

Source: Kimberly-Clark Corp.

ESTIMATED ANNUAL CAPACITIES FOR TISSUE OF MAJOR PRODUCERS

(000 short tons)

	U.S.	Share of U.S. capacity (%)	Canada	Share of Canadian capacity (%)	Company total
1. Scott Paper Co.	1,150	19.3%	110	15.2%	1,260
2. James River Corp.	1,110	18.6	—	—	1,110
3. Fort Howard Corp.	950	15.9	—	—	950
4. Procter & Gamble Co.	815	13.6	—	—	815
5. Kimberly-Clark Corp.	527	8.8	61	8.4	588
6. Georgia-Pacific Corp.	547	9.2	—	—	547
7. Chesapeake Corp.	200	3.3	—	—	200
8. Pope & Talbot Inc.	138	2.3	—	—	138
9. Orchids Paper	95	1.6	—	—	95
10. Dominion Cellulose	—	—	94	13.0	94
11. Marcal Paper Mills Inc.	88	1.5	—	—	88
12. Potlatch Corp.	85	1.4	—	—	85
13. Statler Tissue Corp.	80	1.3	—	—	80
14. Irving Pulp*					75
15. Erving Paper Mills	69	1.2	—	—	69

U.S. annual capacity (1990e): 5.972 million tons
Canadian annual capacity (1990e): 0.723 million short tons

*Breakdown between U.S. and Canada not available.

In July 1990, K-C also announced that it would "soon" ship its first baby wipes product and that it had chosen California for the debut. Baby wipes comprise a $350-million market at the retail level in the U.S., according to K-C, and the sector is growing 5% to 10%/year. K-C will make the nonwoven fabric at its Conway, Ark. facility and then ship it to a new converting plant nearby in Maumelle, Ark., to be made into premoistened wipes.

The leader in the baby wipes field is Scott Paper Co.'s premium Baby Fresh brand, K-C said, and other major contenders are Sterling Drug and Johnson & Johnson. Scott introduced its product in 1976, when the market was valued at $30 million.

Other producers have not lagged in expansions and product introductions. In the first half of 1989, Pope & Talbot Corp. debuted the first private-label, gender-specific diapers in the U.S., aimed for markets east of the Rockies.

Weyerhaeuser Co. came out with its first branded diaper, Giggles. Selling for $7.99 per bag, the product beat out many private-label diaper price tags.

Potlatch Corp., which claims the premier position in private-label and generic tissue products in the U.S., plans to start up a new tissue machine and shut down an old one at its Lewiston, Idaho, mill by 1992. The $95-million effort will bring mill capacity to 124,300 tpy, up from 85,700 tpy. Most of the plant's current output goes to generic and private-label consumer brands, and some parent rolls are sold to converters.

Irving Pulp & Paper Ltd. brought a 60,000-tpy tissue machine online late in 1989 at its St. John, N.B., mill, making it a major supplier of parent rolls of such products as diapers, napkins, and commodity tissue and toweling.

Chesapeake Corp. started up a new machine at its tissue facility in Menasha, Wis., by late June, increasing capacity by 70%. Some of that capacity will be devoted to toweling. The company pointed out that the expansion will bring an end to the purchase and conversion of bulk rolls of tissue—which had been racking up bills of $1 million per month.

The principals of Ponderosa Fibres of America Inc., the world's largest secondary fiber market pulp producer, bought the former Tomahawk Tissue Corp. mill in Tomahawk, Wis., early in 1990. The mill had been idle for a year. Once its tissue machine was restarted, the company began producing 100%-recycled lightweight tissue at the site. Deinked pulp from Ponderosa Pulp Products, Oshkosh, Wis., supplies the plant.

Wisconsin Tissue Mills' 80,000-tpy machine for recycled C&I tissue came online in mid-1990, hiking capacity to 200,000 tpy. And FSC Paper Co. started a 70,000-tpy recycled tissue machine in fourth-quarter 1989.

Perkins Papers will double its 100%-recycled tissue capacity with a new machine slated for 1991 introduction in its Candiac, Que., mill. A new deinking line will bring the cost of the project to C$45 million. The firm produces toilet tissue, towels, napkins, table covers, and place mats for the commercial and consumer markets.

Georgia-Pacific's purchase of Great Northern Nekoosa Corp. has not added any tissue capacity, but Morgan Stanley says the united firms may bring a new machine online in the next few years.

Cascades Inc. started up a 100%-recycled tissue machine at its Kingsey Falls, Que., mill in mid-1990, raising capacity from 40,000 to 65,000 tpy.

U.S. TISSUE PRICES

(BLS price index, 1987 = 100)

Year	Napkins and stock	Toilet tissue and stock	Towels and stock
1990			
2Q	112.9	134.5	121.5
1Q	111.6	131.7	118.9
1989			
4Q	110.7	131.3	119.0
3Q	109.8	118.6	118.4
2Q	108.9	116.3	117.9
1Q	107.3	110.9	116.3
1988			
4Q	103.8	106.8	113.3
3Q	103.1	105.6	110.1
2Q	102.7	103.6	105.4
1Q	100.8	100.8	100.5

Source: U.S. Dept. of Labor, Bureau of Labor Statistics, Producer Price Indexes.

U.S. TISSUE PRICES

(BLS price index, 1982 = 100)

Year	Sanitary paper products, including stock
1990	
2Q	136.1
1Q	133.5
1989	
4Q	132.8
3Q	125.8
2Q	124.4
1Q	120.6
1988	
4Q	117.3
3Q	116.1
2Q	113.3
1Q	109.5
1987	109.1
1986	108.1
1985	106.6
1984	103.4
1983	102.1
1982	100.0
1981	98.2
1980	91.9
1979	79.1
1978	71.7
1977	66.9
1976	60.6
1975	55.0
1974	44.0
1973	35.3
1972	34.2
1971	33.8
1970	32.5

Note: Bureau of Labor Statistics' Producer Price Index was rebased to 1982 = 100 in January 1988. Index now includes sanitary products and stock.
Source: U.S. Dept. of Labor, Bureau of Labor Statistics, Producer Price Indexes.

Paperboard:

INTRODUCTION

Paperboard is a general term describing heavyweight grades of paper used for containers, boxes, cartons, and packaging materials. Paperboard is divided into three classes: containerboard, boxboard, and other paperboard.

Containerboard is the largest single grade of paperboard produced, and it includes three major grade categories: linerboard, corrugating medium, and chip and filler boards. Most of these grades are made from 100% virgin kraft fiber on a fourdrinier paper machine, but some recycled fiber is also used. The bulk of containerboard produced in the U.S. is consumed by domestic corrugated container plants, but a substantial proportion of linerboard—approximately 2.3 million tons in 1989—is exported.

Boxboard grades include 1) folding boxboard, 2) setup boxboard, and 3) foodboard. Folding boxboard is paperboard that is die cut to be folded into a carton. These cartons are used to package health and beauty products, dry cereals, soap powders, electronics, toys and hardware, and other common consumer products. Folding boxboard is made from either solid bleached sulfate (SBS) or solid unbleached sulfate (SUS) kraft pulp on a fourdrinier paper machine, or it can be made from 100% recycled fiber on a multi-ply cylinderboard machine. Folding carton stock is usually clay coated for better printability and consumer appeal.

Setup boxes are rigid or semirigid boxes used in specialty packaging applications. They are custom-produced and usually hand-filled with products such as shoes, jewelry, cosmetics, liquor, and candy. Setup boxes are also used to package personal computer software products.

Foodboard is normally produced from bleached kraft pulp on a fourdrinier paper machine. Several grades are available, each specially coated, waxed, or otherwise treated to handle moist or oily food products. Typical grades are milk cartons, frozen food packages, cupstock, and plates.

Other paperboard includes unbleached kraft or recycled grades that are made on either cylinder or fourdrinier paper machines. These grades are used in industrial converting applications, including fiber can, core, and drum stock and liner for gypsum board. Chipboard (commonly called "cardboard") is used for products ranging from stationery pads to game boards.

Total U.S. paperboard production in 1989 totaled 38.456 million short tons—nearly equal to total paper production of 38.256 million tons, according to the American Paper Institute. Although paper and paperboard production are approximately equal on a tonnage basis, the dollar value of paper shipments is much greater than paperboard. In 1989, the value of paper shipments was $33.367 billion, and the value of paperboard shipments was $16.257 billion, according to data published by the U.S. Bureau of the Census.

Containerboard is the most important paperboard grade segment, with 1989 production for domestic use totaling 24.1 million tons. Boxboard output for the domestic packaging market was 7.1 million tons, and all other types of paperboard totaled 4.1 million tons. Paperboard exports, with linerboard and solid bleached board by far the most important categories, totaled about 3.2 million tons in 1989. About 65% of U.S. paperboard tonnage is produced exclusively from solid woodpulp furnish, while 35% of paperboard contains wastepaper.

The Canadian paperboard industry is much smaller, with a total output in 1989 of roughly 2.7 million metric tons, according to the Canadian Pulp & Paper Assn. Linerboard is the most important grade, with 1989 output of 1.218 million metric tons. Corrugating medium production totaled 726,000 metric tons, and total boxboard production amounted to 729,000 metric tons.

U.S. MARKET INDICATORS FOR PAPERBOARD CONSUMPTION

Year	Paperboard consumption (million tons)	Gross national product[1]	Personal consumption expenditures (billion 1982 constant $) Durable	Nondurable	U.S. total industrial production index (1977 = 100)	Paperboard manufacturing capacity utilization
1989	35,232	4,118	$428.0	$919.9	140.4	94%
1988	34,804	4,017	418.2	909.4	136.8	95
1987	34,253	3,845	391.4	892.7	129.8	96
1986	32,454	3,718	384.4	878.1	125.1	95
1985	30,373	3,607	352.7	849.5	124.2	90
1984	31,551	3,501	323.1	825.9	121.4	94
1983	29,333	3,279	283.1	880.2	109.2	91
1982	26,526	3,166	252.7	771.0	103.1	82
1981	28,741	3,249	250.8	764.9	111.0	91
1980	27,716	3,187	245.9	762.6	108.8	92
1979	29,250	3,192	266.5	766.6	110.7	94
1978	28,335	3,115	267.4	753.7	106.6	93
1977	27,150	2,959	253.9	731.4	100.0	90
1976	26,744	2,827	232.3	708.8	92.6	89
1975	23,311	2,695	205.6	676.5	84.6	79
1970	23,495	2,417	162.5	632.5	78.5	92
1965	20,301	2,088	134.6	543.2	66.1	93
1960	15,475	1,665	98.0	463.3	n.a.	82

Sources: U.S. Dept. of Commerce, American Paper Institute.

1. Real GNP 1982 $.

U.S. PRODUCTION AND CAPACITY OF PAPERBOARD

(000 short tons)

Year	Production[1] (000 tons)	Change (%)	Capacity[1] (000 tons)	Change (%)	Utilization rate(%)
1991e	—	—	43,840	3.8%	—
1990e	—	—	42,352	2.9	—
1989	38,456	0.9%	41,119	2.5	93.5%
1988	38,105	1.8	40,322	2.6	94.5
1987	37,442	5.9	39,106	3.5	95.7
1986	35,355	7.4	37,763	2.8	94.6
1985	32,922	-3.3	36,720	2.0	90.0
1984	34,039	6.5	35,992	1.1	95.6
1983	31,951	9.9	35,603	0.5	89.7
1982	29,065	-6.9	35,421	2.8	82.1
1981	31,232	0.9	34,466	1.6	91.2
1980	30,952	-1.9	33,709	0.8	91.8
1979	31,429	3.8	33,436	2.5	94.0
1978	30,275	4.6	32,631	1.4	92.8
1977	28,953	1.8	32,173	0.2	90.0
1976	28,439	14.8	32,097	2.8	86.0
1975	24,756	—	31,218	—	79.3
Average 1970-88		2.8		2.0	

e = Estimate.

1. Excludes capacity for hard pressed board, wet machine board, and construction paper and board.

Source: American Paper Institute (1989 capacity survey).

U.S. SHIPMENTS[1] OF PAPERBOARD GRADES, 1976-89

(000 short tons)

	1989	1988	1987	1986	1985	1984	1983
TOTAL PAPERBOARD	38,047	37,763	37,187	36,002	33,291	33,515	31,871
SOLID WOODPULP FURNISH PAPERBOARD	28,899	28,492	28,083	27,897	25,293	25,619	24,169
Unbleached kraft packaging, industrial converting	18,795	18,298	18,222	17,997	16,016	16,718	15,750
Unbleached linerboard	17,356	16,902	16,919	16,740	14,897	16,648	14,689
Tube, can, and drum paperboard	60	68	65	54	64	74	99
Other, including corrugating medium	1,379	1,328	1,238	1,202	1,055	996	962
Bleached packaging, industrial converting (80% bleached fiber)	4,906	4,973	4,636	4,535	4,282	4,104	3,988
Linerboard	445	523	405	121	(D)	118	113
Folding carton-type board	2,212	2,245	2,023	2,706	955	1,895	1,901
Milk carton board	1,143	1,092	1,116	1,226	1,227	1,092	1,060
Heavyweight cup stock	426	500	486	442	422	455	440
Plate, dish, and tray stock	323	274	270	276	245	225	252
Bleached paperboard for miscellaneous packaging	73	59	55	45	29	31	31
Other solid bleached board	284	280	281	348	404	288	191
Semichemical, including corrugating medium, other	5,199	5,222	5,226	5,365	4,995	4,798	4,431
RECYCLED PAPERBOARD	9,046	9,169	9,001	8,004	7,901	7,797	7,604
Recycled shipping containerboard	3,090	3,151	3,131	2,495	2,561	2,407	2,565
Linerboard	848	917	1,029	761	918	846	879
Corrugating medium	2,044	2,034	1,950	1,568	1,486	1,397	1,519
Container chip and filler board	198	200	152	167	157	164	167
Recycled folding carton board	2,564	2,589	2,561	2,284	2,268	2,310	2,370
Unlined chipboard	562	556	537	441	468	471	585
Kraft-lined	113	137	162	219	203	169	180
White-lined	142	140	130	168	193	225	227
Clay-coated	1,747	1,756	1,732	1,456	1,401	1,447	1,378
Recycled setup paperboard	292	300	240	273	259	307	263
Recycled packaging, industrial converting board	3,099	3,129	3,070	2,950	2,814	2,772	2,406
Tube, can, and drum stock	1,146	1,151	1,124	1,042	1,021	1,064	858
Gypsum linerboard	1,198	1,239	1,227	1,145	1,029	915	798
Panelboard and wallboard stock	23	35	48	64	68	150	148
Other	733	704	671	698	646	643	602
WET MACHINE BOARD	102	101	103	101	98	99	98
CONSTRUCTION PAPER AND BOARD	2,546	2,486	2,615	2,967	3,228	3,010	3,215
Construction paper	335	356	327	302	398	394	463
Sheathing (red rosin, asphalt, house sheathing)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Felts, saturating and dry							
Roofing felts	239	256	232	210	302	(D)	(D)
Other felts, including floor covering	(D)	90	(D)	(D)	(D)	(D)	(D)
Asbestos and asbestos-filled (e.g., electrolytic)	—	(D)	(D)	(D)	(D)	(D)	(D)
Other building (saturating screenings, etc.)	—	—	—	—	—	(D)	(D)
Structural insulation board		—	—	—	—	—	—
Insulating board	518	529	609	732	735	785	713
Hardpressed board	1,694	1,601	1,683	1,933	2,095	1,831	2,040

Continued

U.S. SHIPMENTS[1] OF PAPERBOARD GRADES, 1976-89 (continued)

(000 short tons)

	1982	1981	1980	1979	1978	1977	1976
TOTAL PAPERBOARD	28,912	30,566	31,143	31,168	30,033	29,006	27,960
SOLID WOODPULP FURNISH PAPERBOARD	22,145	23,950	23,901	23,585	22,500	21,580	21,008
Unbleached kraft packaging, industrial converting	14,390	15,707	15,285	14,903	14,113	13,498	13,146
Unbleached linerboard	13,297	14,431	14,249	13,857	13,215	12,660	12,267
Tube, can, and drum paperboard	151	334	220	232	202	180	194
Other, including corrugating medium	941	942	(D)	(D)	(D)	(D)	(D)
Bleached packaging, industrial converting (80% bleached fiber)	3,757	4,070	4,034	4,065	4,002	3,883	3,846
Linerboard	101	120	(D)	(D)	(D)	93	103
Folding carton-type board	1,743	1,921	2,063	2,045	1,934	1,822	1,888
Milk carton board	1,052	1,085	1,023	1,066	1,048	1,040	1,061
Heavyweight cup stock	418	427	386	375	400	419	363
Plate, dish, and tray stock	227	245	273	260	227	296	267
Bleached paperboard for miscellaneous packaging	32	49	33	46	67	55	70
Other solid bleached board	184	222	78	94	117	106	77
Semichemical, including corrugating medium, other	3,998	4,173	4,583	4,617	4,384	4,199	4,016
RECYCLED PAPERBOARD	6,607	6,616	7,242	7,583	7,533	7,426	6,952
Recycled shipping containerboard	2,097	1,750	2,070	2,050	1,981	1,908	1,468
Linerboard	505	250	518	460	331	379	232
Corrugating medium	1,427	1,315	1,281	1,301	1,408	1,286	1,057
Container chip and filler board	165	185	271	290	242	243	179
Recycled folding carton board	2,153	2,425	2,350	2,386	2,403	2,423	2,475
Unlined chipboard	546	(D)	606	678	692	687	698
Kraft-lined	146	176	81	98	130	133	145
White-lined	152	189	220	229	251	274	325
Clay-coated	1,308	(D)	1,443	1,380	1,330	1,329	1,307
Recycled setup paperboard	238	298	560	604	697	717	748
Recycled packaging, industrial converting board	2,119	2,144	2,262	2,543	2,453	2,378	2,261
Tube, can, and drum stock	767	808	564	628	602	680	747
Gypsum linerboard	598	634	1,036	1,210	1,185	1,099	976
Panelboard and wallboard stock	119	100	113	137	119	114	86
Other	635	601	548	568	546	485	452
WET MACHINE BOARD	172	—[2]	138	144	136	129	130
CONSTRUCTION PAPER AND BOARD	2,781	1,460[3]	4,390	5,436	5,625	5,492	5,419
Construction paper	447	616	1,369	1,868	1,915	1,852	1,832
Sheathing (red rosin, asphalt, house sheathing)	(D)	(D)	3	14	13	21	22
Felts, saturating and dry							
Roofing felts	(D)	510	1,205	1,633	1,672	1,601	1,553
Other felts, including floor covering	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Asbestos and asbestos-filled (e.g., electrolytic)	(D)	(D)	62	100	113	106	114
Other building (saturating screenings, etc.)	(D)	(D)	(D)	(D)	(D)	(D)	(D)
Structural insulation board	—	—	3,021	3,569	3,710	3,640	3,586
Insulating board	593	845	1,051	1,263	1,416	1,403	1,441
Hardpressed board	1,741	(S)	1,970	2,306	2,294	2,237	2,145

Note: Categories shown are those now used by Bureau of the Census. Categories in older reports do not always correspond to the present ones.
(D) = Data withheld to avoid disclosing figures for individual companies.
(S) = Suppressed because the data did not meet publication standards by Bureau of the Census.
1. Reported as production by Bureau of the Census prior to 1981.
2. Wet machine board included with recycled paperboard to avoid disclosing figure for individual companies.
3. Excludes hardboard.
Source: Bureau of the Census.

U.S. PRODUCTION OF CONTAINERBOARD FOR DOMESTIC USE

(000 short tons)

		Linerboard			Corrugating materials			
Year	Total	Kraft[1]	Recycled	Total	Semichemical and kraft	Recycled	Total	Chip and filler boards
1989	23,752.0	16,011.0	388.0	16,399.0	5,554.0	1,785.0	7,339.0	14.0
1988	23,563.2	15,770.7	406.6	16,177.3	5,527.7	1,823.2	7,350.9	35.0
1987	23,047.1	15,514.4	478.3	15,992.7	5,343.8	1,673.1	7,016.9	37.5
1986	21,446.0	14,305.5	420.3	14,725.8	5,163.5	1,525.8	6,689.3	30.9
1985	20,042.2	13,467.1	285.8	13,752.9	4,896.6	1,358.8	6,255.4	33.9*
1984	20,855.1	14,068.8	203.7	14,272.5	5,018.9	1,385.4	6,404.3	178.4
1983	19,173.0	12,835.6	289.1	13,124.7	4,532.7	1,305.4	5,838.1	210.2
1982	17,507.5	11,656.5	279.0	11,935.5	4,202.5	1,139.3	5,341.8	230.2
1981	19,040.4	12,754.3	324.2	13,078.5	4,561.2	1,140.9	5,702.1	259.5
1980	18,070.2	11,948.6	444.5	12,393.1	4,398.5	1,047.1	5,445.6	231.5
1979	18,824.8	12,417.3	402.3	12,819.6	4,573.6	1,202.3	5,775.9	229.3
1978	17,908.2	11,877.2	256.4	12,133.7	4,305.3	1,197.7	5,503.1	271.5
1977	17,167.3	11,354.4	341.3	11,695.7	4,128.2	1,079.7	5,207.9	263.7
1976	16,700.2	11,093.2	282.7	11,375.9	3,986.5	1,075.1	5,061.5	262.9
1975	14,586.2	9,646.9	207.3	9,854.2	3,579.4	870.0	4,449.3	282.6
1970	13,964.3	9,133.4	269.7	9,403.1	3,404.7	859.3	4,264.0	297.2

*Reclassification. Balance of chipboard (noncontainer grades) not included.

1. Includes some bleached kraft linerboard—178,000 tons (1989).

Source: American Paper Institute.

U.S. PRODUCTION OF BOXBOARD AND OTHER PAPERBOARD FOR DOMESTIC AND EXPORT USE

(short tons)

	Boxboard—domestic use				
Year	Total	Folding	Setup	Milk carton and food service	Other*
1989	7,076,000	5,370,000	288,000	1,419,000	7,628,000
1988	7,013,600	5,292,200	278,700	1,442,700	7,527,800
1987	6,874,100	5,209,700	242,500	1,421,900	7,520,800
1986	6,671,100	5,056,500	219,300	1,395,300	7,238,300
1985	6,412,800	4,805,100	226,600	1,381,100	6,466,800
1984	6,535,600	4,876,000	263,800	1,395,800	6,648,500
1983	6,261,100	4,646,000	256,300	1,358,800	6,742,700
1982	5,841,000	4,333,700	223,600	1,283,700	5,716,900
1981	6,216,100	4,587,600	236,000	1,392,500	5,976,100
1980	6,153,100	4,489,900	241,500	1,421,700	6,729,000
1979	6,469,200	4,720,500	306,000	1,442,700	6,135,000
1978	6,501,200	4,702,400	332,700	1,466,100	5,865,500
1977	6,332,300	4,546,700	302,500	1,483,100	5,453,500
1976	6,564,700	4,714,600	331,500	1,518,600	5,174,500
1975	5,663,800	3,896,400	304,500	1,462,900	4,505,700
1970	6,238,700	4,079,700	466,500	1,692,500	5,180,000

*Including other boxboard—4,089,000, boxboard exports—863,000, other containerboard—307,000, and containerboard exports—2,369,000.

Source: American Paper Institute. •

CANADIAN PAPERBOARD CAPACITY

(000 short tons)

	Linerboard		Corrugating medium		Solid bleached board	Boxboard Folding, others[1]
Year	Kraft	Recycled	Semichemical	Recycled		
1991e	1,196	416	718	180	218	854
1990e	1,186	416	708	175	163	838
1989	1,076	408	668	173	69	814
1988	1,076	402	623	170	69	785
1987	1,036	361	609	157	68	782
1986	1,022	325	586	161	80	774
1985	1,001	321	565	172	92	787
1984	983	314	576	164	95	785
1983	952	315	581	129	98	747
1982	969	300	564	150	104	732
1981	1,069	322	557	129	102	770
1980	1,056	289	545	114	105	785
1979	1,074	267	520	115	137	832
1978	1,069	272	517	116	135	812
1977	1,300	278	510	116	131	757

1. Includes mill wrappers but excludes solid bleached board.
Source: Canadian Pulp & Paper Assn.

CANADIAN EXPORTS OF PAPERBOARD[1]

(000 short tons)

Year	Linerboard	Corrugating medium	Boxboard
1989	344	212	112
1988	348	246	75
1987	358	241	88
1986	352	220	73
1985	321	151	69
1984	271	218	95
1983	310	197	63
1982	213	158	31
1981	295	170	37
1980	361	201	40
1979	288	157	39
1978	283	177	54
1977	393	105	20
1976	318	90	7
1975	198	53	11
1974	414	96	22
1973	311	140	23
1972	222	147	17
1971	173	133	22
1970	201	102	13
1965	123	46	16

1. Canadian imports of paperboard are minor. For example, in 1986, Canada imported 43,000 tons of containerboard.
Source: Canadian Pulp & Paper Assn.

CANADIAN PAPERBOARD PRODUCTION

(000 short tons)

	Containerboard		Boxboard				
Year	Linerboard	Corrugating medium	Folding	Non-folding	Bleached board	Other[1]	Total paperboard
1989	1,340	798	368	62	79	220	2,939
1988	1,371	781	358	62	64	238	2,970
1987	1,383	769	n.a.	n.a.	n.a.	n.a.	2,966
1986	1,322	714	391	114	—[2]	353	2,836
1985	1,187	549	385	111	—[2]	332	2,564
1984	1,128	626	363	142	—[2]	329	2,588
1983	1,026	589	355	128	—[2]	295	2,391
1982	967	466	305	115	—[2]	270	2,123
1981	1,182	571	331	130	—[2]	328	2,541
1980	1,224	527	310	118	—[2]	322	2,499
1979	1,145	483	315	119	—[2]	373	2,434
1978	1,146	459	272	133	—[2]	354	2,364
1977	1,011	376	238	133	—[2]	209	2,066
1976	1,025	373	224	80	—[2]	272	1,974
1975	784	343	192	101	—[2]	238	1,658
1970	776	373	250	111	107	233	1,850
1965	595	251	265	104	89	250	1,553
1960	375	208	233	65	14	172	1,067
1955	259	158	186	48	—	219	869
1950	214	152	158	48	4	204	708

n.a. = Not available.

1. Includes solid bleached board, mill wrappers, gypsum or plaster board, wet machine board, etc. from 1975 on.

2. Included in "Boxboard, Other."

Source: Canadian Pulp & Paper Assn.

Paperboard:

LINERBOARD

Linerboard is a commodity grade of paperboard used in the production of corrugated containers. It is used as the inner and outer facing (liner) in combination with corrugating medium (the fluted inner sheet) to form the rigid structure of the combined board. Linerboard provides the strength component of a container, while corrugating medium gives rigidity or stiffness. Linerboard is sold in rolls; the width of the roll is determined by corrugator width.

Unbleached linerboard is made in a wide range of basis weights. The standard kraft liner is 42 lb/1,000 ft^2, but other important grades are produced in weights of 26, 33, 38, 69, and 90 lb. About 86% of linerboard is unbleached kraft (including mottled white), and the remainder is either solid bleached or recycled. Kraft linerboard is produced at large, integrated kraft pulp and paper mills. About 83% of U.S. linerboard capacity is located in the South, and most of the rest is in the West. Some linerboard is also produced in eastern Canada and British Columbia. (See Corrugating Medium chapter for discussion of the Canadian industry.)

Most linerboard is produced on wide (220- to 348-in. trim) conventional fourdrinier paper machines at speeds approaching 2,000 fpm or more. About 60% of industry capacity is now represented by machines with capacity to produce 300,000 to 500,000 tpy. Approximately 90% of the linerboard paper machines in the industry have been installed or substantially rebuilt in the last two decades.

Normally, the wet end of the fourdrinier machine used to manufacture linerboard has two forming devices or headboxes that form two different plies, or layers, of fiber. The primary layer, comprising up to 85% of the fiber furnish, contains coarse, strong, high-yield kraft fiber, which means that a minimum amount of the natural binding chemicals contained in the wood are removed during the pulping process. The top layer contains higher-quality pulp (of either lower fiber yield or highly refined) with better sheet properties that permit a good printing surface. In some grades, the top layer may be bleached fiber that is used to produce a mottled white appearance over an unbleached basesheet.

Special chemical additives are either mixed into the pulp slurry or extruded onto the surface of the formed sheet to give linerboard its unique properties. The most common internal additives are sizes and wet-strength agents used to develop desired sheet strength and moisture resistance. About 4% of linerboard produced in the U.S. is wet-strength treated. The most common surface additive is starch, which is applied at a size press on the paper machine in order to seal the surface of the sheet for increased strength and printing smoothness.

Compression strength. Basis weight and bursting strength have historically been the two main quality specifications for linerboard under freight-carrier classifications (railroad Rule 41 and trucking Item 222) that regulate corrugated shipping containers. Bursting strength is simply a

U.S. STATISTICS FOR UNBLEACHED KRAFT LINERBOARD

	1990e	1989	1988
Production, 000 tons	18,350	18,056	17,897
Capacity, 000 tons	19,781	19,195	18,705
Utilization rates[1], %	92.8	94.1	95.7
Imports[1], 000 tons	110	85	86
Exports, 000 tons	2,308	2,098	2,150
Apparent U.S. consumption			
000 tons	16,147	16,043	15,833
lb/capita	129.2	129.2	129.1
000 tons/billion $ real GNP	3.8	3.9	3.9

e = Estimate.
1. Dept. of Commerce data.
Sources: American Paper Institute, *Pulp & Paper* estimates.

measure of how well a corrugated container will protect its contents during individual loading into railroad cars. Recently, many mills have begun producing linerboard and corrugating medium that also meet certain minimum ring-crush standards. Ring crush relates to the top-to-bottom compression strength of the finished corrugated box, which is a critical measure of stacking height.

Increased transport and stacking of boxes on pallets has made compression strength an important measure of box performance. (See Converted Products chapter.) The movement toward performance-based packaging emphasizes the strength-to-weight ratio of corrugated packaging. Many companies have developed high-strength linerboard that allows box makers to use lighter-weight yet stronger packaging while reducing costs. This also reduces mill costs because less fiber is required to impart strength, and the linerboard produced typically has a lower basis weight, thus reducing fiber use overall.

Among the largest producers of such containerboard are Union Camp Corp., Georgia-Pacific Corp., Stone Container Corp., and International Paper Co. Although the industry has no standard definition for such grades, some industry managers define high-performance containerboard as those grades of linerboard offering at least two pounds of ring-crush strength for each pound of basis weight.

The railroad and truck classification committees are currently considering changes in Rule 41 and Item 222 that would do the following: 1) replace mullen with compression strength as the most important measurement of box performance and 2) eliminate mandatory basis weight requirements. These changes, which could be approved by early 1991, would encourage the use of lighter-weight linerboard as long as it had the required ring crush or STFI (Swedish Pulp & Paper Research Institute) value.

Secondary fiber use. Unbleached kraft linerboard is made mainly from softwood trees (southern pine, Douglas fir, and eastern pines and spruces), but some mills have also traditionally used some hardwood species in the pulp furnish. In the past few years, the use of wastepaper fiber in kraft linerboard manufacture has also grown, increasing from 4% of total fiber furnish in the late 1970s to around 13% currently. The principal wastepaper grades used are old corrugated containers (OCC) and new double-lined kraft cuttings (DLK). Usage varies, but the maximum amount of wastepaper consumed by any kraft linerboard mill is generally not over 25% of total fiber furnish.

A few U.S. mills produce linerboard from 100% wastepaper on either fourdrinier or multi-ply cylinder machines. This grade is called "test" linerboard and is typically produced in heavier basis weights. Currently, recycled linerboard supplies about 3% of total domestic linerboard demand. Test liner has traditionally filled the gap when kraft linerboard is in short supply, a situation that occurred in both 1980 and 1987 when production jumped to nearly 500,000 tons. In both cases, production declined the following year as the kraft linerboard supply/demand equilibrium was reestablished.

The main motivation for building recycled linerboard capacity is the low capital cost of new mill construction—equivalent to approximately $250,000/daily ton of capacity vs about $400,000/daily ton of capacity for construction of a new greenfield kraft linerboard mill. Another is growing interest by customers in buying corrugated containers with a high secondary fiber content as a way of demonstrating concern about the environment and growing solid waste problem. In addition, government regulations and tax incentives are being used to promote wastepaper recycling.

Another attraction is the

U.S. PRODUCTION AND CAPACITY OF UNBLEACHED LINERBOARD

(000 short tons)

Year	Production		Capacity		Operating rate (%)
	Tonnage	Change (%)	Tonnage	Change (%)	
1992e	—	—	21,280	3.6%	—
1991e	—	—	20,543	3.9	—
1990e	18,345	1.6%	19,781	3.1	92.7%
1989e	18,056	0.9	19,195	2.6	94.1
1988	17,897	0.2	18,705	1.6	95.7
1987	17,863	8.9	18,415	7.2	97.0
1986	16,402	8.0	17,175	2.6	95.4
1985	15,183	-5.3	16,739	1.1	90.7
1984	16,037	6.9	16,565	1.8	96.8
1983	15,007	11.2	16,217	1.5	92.5
1982	13,494	-7.2	16,032	4.3	84.2
1981	14,540	2.2	15,372	5.2	94.6
1980	14,232	2.0	14,586	2.7	97.6
1979	13,951	5.5	14,199	2.4	98.3
1978	13,228	5.2	13,864	1.9	95.4
1977	12,573	2.6	13,586	1.4	92.5
1976	12,251	12.4	13,448	2.4	91.1
1975	10,635	-10.6	13,138	1.8	80.9
1974	12,333	-3.7	12,901	0.3	95.6
1973	12,536	4.4	12,862	2.3	97.5
1972	12,335	9.1	12,568	6.5	98.1
1971	11,308	3.0	11,797	0.6	95.9
1970	10,982	0.3	11,718	—	93.7

e = Estimate.
Sources: American Paper Institute, *Pulp & Paper* estimates.

availability of low-cost fiber near major metropolitan areas of the Northeast, Midwest, and West Coast.

As a result, a growing number of linerboard projects are being planned based mainly on secondary fiber. Temple-Inland Corp. constructed a new 175,000-tpy recycled linerboard mill in Ontario, Calif., in 1985—the first such facility to be built in the U.S. using modern recycling technology. Earlier, the company built the first modern recycled medium mill at Newport, Ind., in 1975. More recently, Inland announced plans to build a 214,000-tpy recycled linerboard

MONTHLY CONTAINERBOARD INVENTORY AT U.S. BOX PLANTS AND MILLS

(000 short tons/weeks of supply*)

	1990**		1989		1988		1987		1986	
Month	Tons	Weeks	Tons	Weeks	Tons	Weeks	Tons	Weeks	Tons	Weeks
Jan. 1	2,589	5.9	2,553	5.4	2,486	5.7	2,238	6.0	2,549	7.1
Feb. 1	2,685	5.7	2,707	5.6	2,663	5.7	2,340	5.6	2,502	5.7
Mar. 1	2,559	5.6	2,612	5.8	2,584	5.8	2,391	5.4	2,489	6.1
Apr. 1	2,626	5.8	2,569	5.7	2,513	5.7	2,414	5.6	2,518	6.2
May 1	2,593	5.2	2,564	5.1	2,552	5.1	2,375	5.2	2,438	5.5
June 1	2,542	5.5	2,495	5.5	2,595	5.9	2,383	5.6	2,394	6.1
July 1	2,503	5.3	2,475	5.5	2,617	6.0	2,385	5.4	2,320	5.5
Aug. 1	2,652	5.5	2,687	5.5	2,723	5.9	2,497	5.6	2,389	5.7
Sept. 1	2,617	5.6	2,664	5.8	2,731	6.2	2,437	5.5	2,344	5.8
Oct. 1	2,558	4.9	2,642	5.5	2,672	5.8	2,421	5.2	2,269	5.2
Nov. 1	—	—	2,460	4.9	2,519	5.0	2,352	5.0	2,181	4.8
Dec. 1	—	—	2,449	5.2	2,487	5.3	2,396	5.7	2,134	5.3

	1985		1984		1983		1982		1981	
Month	Tons	Weeks	Tons	Weeks	Tons	Weeks	Tons	Weeks	Tons	Weeks
Jan. 1	2,882	8.4	2,437	7.2	2,584	8.9	2,729	9.4	1,984	6.2
Feb. 1	2,970	7.4	2,408	6.0	2,485	7.1	2,482	7.5	1,960	5.5
Mar. 1	2,955	7.7	2,467	6.4	2,462	7.2	2,468	7.3	2,029	5.6
Apr. 1	3,023	8.0	2,448	6.4	2,414	6.8	2,570	7.4	2,104	5.7
May 1	2,987	7.3	2,512	6.2	2,495	6.9	2,656	7.6	2,232	5.9
June 1	2,945	7.6	2,541	6.5	2,463	6.8	2,671	8.1	2,298	6.7
July 1	2,838	7.5	2,659	7.1	2,511	6.8	2,650	7.9	2,368	6.7
Aug. 1	2,821	7.3	2,767	7.2	2,486	7.4	2,595	8.3	2,371	6.9
Sept. 1	2,694	7.0	2,711	7.0	2,421	6.6	2,553	7.5	2,376	6.9
Oct. 1	2,560	6.1	2,702	6.9	2,339	6.0	2,393	6.5	2,451	6.6
Nov. 1	2,492	5.8	2,602	6.2	2,302	5.8	2,424	6.9	2,437	7.1
Dec. 1	2,469	6.6	2,650	7.1	2,415	6.5	2,524	7.6	2,602	7.9

	1980		1979		1978		1977		1976	
Month	Tons	Weeks	Tons	Weeks	Tons	Weeks	Tons	Weeks	Tons	Weeks
Jan. 1	1,979	6.2	1,961	5.8	2,437	7.2	2,507	8.0	2,185	7.2
Feb. 1	1,991	5.3	1,825	5.1	2,297	7.0	2,376	7.8	2,136	7.0
Mar. 1	1,905	5.4	1,807	5.1	2,242	6.6	2,393	7.7	2,138	7.1
Apr. 1	1,890	5.4	1,789	5.0	2,208	6.1	2,412	7.5	2,172	7.0
May 1	2,021	5.7	1,846	4.8	2,179	6.4	2,463	7.4	2,316	7.4
June 1	2,119	6.5	1,856	5.2	2,155	6.0	2,513	7.5	2,393	7.5
July 1	2,248	7.0	1,863	5.3	2,169	6.1	2,577	8.0	2,506	8.2
Aug. 1	2,291	7.3	1,939	5.5	2,206	6.6	2,581	8.3	2,539	8.4
Sept. 1	2,225	7.1	1,945	5.6	2,119	6.0	2,613	8.0	2,604	8.5
Oct. 1	2,101	5.8	1,938	5.3	2,004	5.5	2,457	7.2	2,442	7.7
Nov. 1	1,880	5.6	1,877	4.8	1,923	5.1	2,439	7.1	2,456	7.6
Dec. 1	1,836	5.5	1,953	5.5	1,939	5.6	2,442	7.2	2,516	7.9

*Obtained by dividing inventories by average weekly usage in corrugated box plants during prior month, excluding holidays.
**Preliminary.
Source: Fibre Box Assn.

RATIO OF U.S. CONSUMPTION OF PAPERBOARD TO CORRUGATED CONTAINER PRODUCTION

CORRUGATING MEDIUM TONNAGE FOR CONTAINERS

Year	Consumption by box plants (000 short tons) Liner-board	Corrugating medium	Ratio (liner/ medium)
1989	16,037	7,488	2.14
1988	15,751	7,317	2.15
1987	15,276	7,086	2.16
1986	14,414	6,689	2.15
1985	13,605	6,247	2.17
1984	13,461	6,177	2.18
1983	12,594	5,768	2.18
1982	11,751	5,337	2.20
1981	12,262	5,530	2.22
1980	12,019	5,427	2.21
1979	12,456	5,654	2.20
1978	12,168	5,495	2.21
1977	11,318	5,103	2.22
1976	10,782	4,844	2.22
1975	9,609	4,320	2.22
1974	10,621	4,746	2.24
1973	11,315	5,060	2.24
1972	10,429	4,698	2.22
1971	9,465	4,273	2.22
1970	9,079	4,107	2.21

LINERBOARD TONNAGE FOR CONTAINERS

Year	Corrugator production (billion ft²)	Linerboard consumed by box plants (000 tons)	Ratio (1,000 ft²/ ton)
1989	336.3	16,037	20.970
1988	329.4	15,751	20.913
1987	318.5	15,276	20.850
1986	302.0	14,414	20.950
1985	284.8	13,605	20.933
1984	282.0	13,461	20.949
1983	264.2	12,594	20.980
1982	246.3	11,751	20.960
1981	253.0	12,262	20.633
1980	251.9	12,019	20.958
1979	261.1	12,456	20.962
1978	256.4	12,168	21.072
1977	238.8	11,318	21.099
1976	227.8	10,782	21.128
1975	203.2	9,609	21.147
1974	224.1	10,621	21.100
1973	238.5	11,315	21.078
1972	220.1	10,429	21.105
1971	200.3	9,465	21.162
1970	192.7	9,079	21.225
		Average:	21.016

Source: Based on data from Fibre Box Assn.

mill in Maysville, Ky., for completion in 1993. Total cost of the mill (which can be expanded from 600 tpd to 775 tpd in capacity and which would buy steam from an adjacent utility power plant) is $176 million. The new mill would incorporate all of the latest technology, including multi-ply forming on the paper machine, caustic soaking to loosen contaminants, and fine-particle removal.

Stone Container has announced plans to convert one machine at its Seminole Kraft affiliate in Jacksonville, Fla., to production of 400,000 tpy of 100% wastepaper-based recycled linerboard. Jefferson Smurfit Corp. plans to reactivate a machine at its Fernandina, Fla., mill producing about 210,000 tpy of recycled containerboard. And Dunkirk Containerboard, a new company formed by Domtar Inc. with about eight independent box converters, is studying a new 250,000-tpy recycled linerboard mill that would be built in Dunkirk, N.Y. Daishowa Paper of Japan with a U.S. independent converter has proposed building a 350,000-tpy containerboard mill in Stockton, Calif., using 100% wastepaper. Plans by Kenaf of North America Inc. to build a 265,000-tpy recycled linerboard mill in Muskogee, Okla., however, appear to have been delayed.

All of the new projects, however, are raising some concern as to whether there will be enough OCC available at a reasonable price to supply all of the future domestic consumption plus rising export demand. The U.S. recovery rate for OCC, already slightly above 50%, could rise to 63% in 1995, according to Franklin Associates. And some consultants estimate the rate could climb to the 70% to 80% range as prices rise. While there may not be enough OCC and DLK available, some mills are beginning to experiment with the use of other types of wastepaper fiber. Green Bay Packaging Inc., for example, is experimenting with the use of mixed office papers and newsprint for the top ply of linerboard grades offering white and gray surfaces for improved graphic quality.

Graphic display. Most U.S. linerboard is unbleached, but grades with a solid white or mottled white printing surface are growing in importance. Currently, they account for about 8% of total production. This reflects growing use of corrugated containers for point-of-purchase display in retail outlets. The most common grade for this application is mottled white linerboard, in which a thin layer of bleached fiber is added to the top of an unbleached sheet for a swirled effect. Production of mottled white board in 1989 totaled more than 1.14 million tons, and it has grown 7% to 8%/year since 1980. The largest producers are Container Corp. of America and St. Joe Paper Co., followed by Green Bay Packaging and Chesapeake Corp. Through most of 1990, production of mottled white was running about 8% ahead of a year ago vs a flat performance for regular unbleached kraft.

A higher-quality, more expensive alternative is solid bleached linerboard. Production of this grade in 1989 totaled 178,000 tons, and it has grown at a 9%/year rate since 1980. Temple-Inland Inc. is believed to be the largest supplier of solid bleached linerboard.

A third alternative is the use of clay-coated unbleached kraft board in the preprint process. (See Coated and Uncoated Kraft Board chapter and Converted Paper and Board Products chapter.) Use of such coated board is believed small because preprint has been slow to develop high-volume applications and because supply is limited. More clay-coated board for linerboard applications will become available with the startup of Mead Corp.'s 420,000-tpy clay-coated kraft board machine in the fall of 1990.

In late 1989, Chesapeake introduced a white-top linerboard grade that it hopes will open the high-volume end of the high-quality graphics market for preprint. Green Bay Packaging in 1990 came out with a white-top sheet made from recycled white paper. Inland Container Corp. is rebuilding a machine at its Orange, Texas, mill to produce 500 tpd of white-top board (using bleached pulp from its nearby Evadale, Texas, mill). Production of such white-top and coated kraft grades is expected to grow rapidly in the U.S. over the next five years. (Detailed information on these changing quality trends is available in *Growing Linerboard Specialties: White Grades and High-Performance Grades*, written by Coleman Rowland and published by *Pulp & Paper* Forecasting Services.)

Multi-ply forming. The need for linerboard with higher cross-machine strength (measured by ring crush) and with better printing surfaces led to growing interest in multi-ply linerboard forming. Beyond the traditional fourdrinier and secondary headbox, some U.S. companies are adding top-wire dewatering units or mini-fourdriniers to produce two- or three-ply sheets. Willamette Industries Inc. recently added Bel Bond formers to all of its linerboard machines, and several other companies are planning similar installations. Georgia-Pacific Corp. recently rebuilt its No. 2 machine with an Escher Wyss top-former fourdrinier to produce a two-ply board. In 1985, Chesapeake's West Point, Va., mill started up a new Voith machine with four forming sections to produce a three-ply sheet.

FACTORS FOR CONVERTING PRICES FROM $\$/\text{TON}$ TO $\$/1{,}000\ \text{FT}^2$, AND FROM $\$/1{,}000\ \text{FT}^2$ TO $\$/\text{TON}$

Basis weight (lb/1,000 ft^2)	FACTOR 1 $\$/1{,}000\ \text{ft}^2$ to $\$/\text{ton}$	FACTOR 2 $\$/\text{ton}$ to $\$/1{,}000\ \text{ft}^2$
26*	76.92	0.01300
31*	64.52	0.01550
33*	60.61	0.01650
36*	55.56	0.01800
38	52.63	0.01900
42	47.62	0.02100
47	42.55	0.02350
69	28.98	0.03451
90	22.22	0.04500

To convert the price per 1,000 ft^2 to equivalent price on a per-ton basis, multiply the price by FACTOR 1. For example, if the price of 33-lb linerboard is $\$4.79/1{,}000\ \text{ft}^2$, multiply $\$4.79$ by 60.61. The price per ton is $\$290$.

To convert the price per ton to equivalent price per 1,000 ft^2, multiply price by FACTOR 2.

*Corrugating medium weights. Linerboard is normally produced at 26, 33, 38, 42, 47, 69, and 90 lb/1,000 ft^2.

These machines can use different fiber furnishes and also produce partially bleached grades such as white-top or mottled board. Low cross-machine variation in basis weight and moisture profile is important for high-speed converting.

High-pressure presses. Companies are installing high-impulse or wide-nip presses to add incremental capacity and to improve sheet strength. High-impulse presses make use of higher-than-usual linear press loadings—typically 1,000 to 2,000 psi or greater—as well as double felting and a nip width of 3.0 to 3.5 in. Wide-nip presses (such as Beloit Corp.'s Extended Nip Press) usually increase nip pressure in the press section by passing a sheet between a single-grooved press roll opposed by a stationary loaded shoe. Pressure equivalent to 4,500 to 6,000 pli can be achieved because of the longer dwelltime of the sheet in the double-felted press (with nips ranging up to 10 in.).

The increased pressure can reduce steam requirements per ton in the dryer section by as much as 15% to 25%. It can also boost incremental capacity by 10% to 15% or more. Dryness of the sheet leaving the press can be raised to over 50%, and some mills are installing tandem high-intensity or wide-nip press sections to achieve after-press dryness levels approaching 60%. Wide-nip presses also increase sheet strength, or permit mills to use more secondary or hardwood fiber while maintaining the same strength level.

Weyerhaeuser Paper Co. mills in Springfield, Ore., and Plymouth, N.C., pioneered the installation of Beloit's Extended Nip Press on linerboard machines in the early 1980s. Several other companies have since installed high-impulse or wide-nip presses, and other suppliers besides Beloit have developed presses that achieve similar results. In a project completed in mid-1989, International Paper became the first U.S. producer to install a double wide-nip

CURRENT LINERBOARD GRADE STRUCTURE*

Basis weight (lb/1,000 ft^2)	Grade distribution (%)
26	4%
33	12
38	4
42	50
47	1
69	22
90	3
other	4

*For domestic use.
Source: Fibre Box Assn., 1988.

press (Voith Flex-o-Nip) at its Vicksburg, Miss., mill. Gaylord Container Corp.'s new machine at Bogalusa, La., will have multi-ply forming and two Extended Nip Presses.

MARKET STRUCTURE

The U.S. linerboard industry in 1989 produced 18.3 million tons of kraft linerboard, of which approximately 2.1 million tons were exported. (As previously noted, the industry also produced 388,000 tons of recycled linerboard and 178,000 tons of solid bleached linerboard.)

CAPACITY RANKING OF U.S. LINERBOARD PRODUCERS

	Company	Annual capacity (000 short tons)	Capacity share (%)
1.	Stone Container	2,890^1	14.0
2.	Georgia-Pacific	2,685^2	13.2
3.	International Paper	1,820	8.9
4.	Jefferson Smurfit/CCA	1,560	7.7
5.	Weyerhaeuser	1,555	7.6
6.	Temple-Inland	1,445^3	7.1
7.	Union Camp	1,375^4	6.8
8.	Gaylord Container	1,050^5	5.2
9.	Packaging Corp. of America	790^6	3.9
10.	Willamette Industries	780	3.8
11.	Westvaco	620	3.0
12.	Macon Kraft	550	2.8
13.	Longview Fibre	510	3.0
14.	St. Joe Paper	490	2.5
15.	Green Bay Packaging	475	2.3
16.	MacMillan Bloedel	450	2.2
17.	Boise Cascade	435	2.1
18.	Chesapeake	350	1.8
19.	Champion International	345	1.7
20.	Interstate Resources	290	1.4
21.	Simpson Paper (Simpson Tacoma Kraft)	215	1.1

Total U.S. capacity (1990): 20.339 million tons
(kraft and recycled)
Capacity share of top five companies: 51.7%
Capacity share of top ten companies: 78.4%

1. Includes all of Stone Container's 60%-owned Seminole Kraft Corp. mill in Jacksonville, Fla., (total liner capacity 350,000 tpy). Excludes linerboard mills in Canada (216,000 tpy), Europe, and Mexico.
2. Includes former Great Northern Nekoosa liner mills at Cedar Springs (905,000 tpy) and Valdosta (395,000), Ga., acquired in early 1990. G-P plans to sell Valdosta to PCA/GE Capital and is trying to sell its its Toledo, Ore., (397,000) liner mill.
3. Includes 210,000-tpy recycled liner mill in Ontario, Calif.
4. Does not reflect 235,000-tpy net addition to capacity from new 460,000-tpy linerboard machine expected to begin production in early 1991.
5. Includes total capacity of new 357,000-tpy machine that started up at Bogalusa, La., mill in July 1990, although its actual production for the year was less than half, and full capacity will not be reached until 1991.
6. Does not include Valdosta, Ga., mill (395,000 tpy) being acquired from Georgia-Pacific by the end of 1990.

Source: *Pulp & Paper* estimates.

The U.S. linerboard industry has a fairly high degree of integration, with about 73% of production transferred by companies to their own box plants or swapped with other producers to save on freight costs. About 15% of production is sold by producers to independent corrugated converters, and the remaining 11% to 13% is exported overseas. A small amount of linerboard also finds its way into miscellaneous uses such as tube, can, and core stock.

The two main determinants of linerboard demand are domestic corrugated box production and linerboard export shipments. In turn, corrugated box shipments closely track U.S. industrial production, and over the past decade (1980-89), they grew at a 2.3%/year rate. Linerboard production during the same period grew at a 2.8%/year rate. Linerboard exports were actually flat over this period after hitting an unusually high spike of 2.5 million tons in 1980, reflecting heavy purchases from China. In 1990, however, exports should hit a new peak of around 2.9 million tons (based on Dept. of Commerce shipment figures), and future growth should outpace domestic consumption because of growing demand from Far East markets and favorable cost position of U.S. linerboard producers.

Linerboard prices tend to be highly cyclical, usually rising during the middle and later stages of an economic recovery but falling when demand weakens and producers scrape for business to keep their capital-intensive mills running. Pricing tends to be strongest when operating rates are around 95% or higher and when inventories are below about 5.5 weeks of supply—however, "market psychology" is an important factor. Normally, linerboard prices tend to push up corrugated container prices. Containerboard raw materials account for about 50% to 55% of the cost of making a corrugated container.

In market downturns, prices sometimes drop nearly to variable manufacturing costs (including delivery). The largest cost factor in producing linerboard is wood, which accounts for about 36% of total manufacturing costs (including interest and depreciation). Labor accounts for 13% of total costs, followed by energy (8% to 9%) and chemicals (5%). Domestic delivery costs average about $30 to $35/ton, while delivery costs are about $40 to $50/ton to Europe and about $55 to $70/ton to the Far East.

CURRENT MARKET CONDITIONS

The linerboard industry went into a sharp slump in 1985 due to the strong U.S. dollar, which depressed U.S. linerboard export shipments. Linerboard exports dropped from 2.3 million tons in 1983 to a low of 1.8 million tons in 1985. Domestic demand was not strong enough to absorb the excess tonnage, and containerboard inventories at box plants and mills began to mount, hitting a record 3.0 million tons (8.0 weeks of supply) in the spring of 1985.

The price of linerboard dropped from a peak of $340/ton in the fall of 1984 to a low of about $250 to $260/ton in the second half of 1985. Average mill net prices were even lower because of $10 and $20/ton zone rebates based on shipping distance from mills and because of abysmal export prices. Such price levels were far below the estimated $270 to $290/ton break-even level for an average southern mill (including depreciation and freight). What helped limit the gush of red ink for many integrated producers was the fact that corrugated box prices eroded more slowly than linerboard prices. While linerboard prices declined by about 25% during this period, corrugated box prices eroded only about 12%.

Producers took heavy downtime in 1985 to bring supply into better balance with demand. Operating rates for the year averaged under 91%—down from 97% the preceding year. Demand began to improve in 1986, helped by the weakened dollar, which revived U.S. corrugated box shipments (up 6.2% for the year) and linerboard exports. Linerboard production in 1986 rose 8%, and export shipments surged 20% to nearly 2.2 million tons. Inventories of containerboard dropped back to 2.2 million tons (4.8 weeks of supply) by the end of 1986. Producers pushed through a $30/ton price increase to $290/ton in April and implemented another increase to $320/ton in the fall.

The market continued to tighten during the next year, with linerboard mill operating rates rising from 95% in 1986 to 97% in 1987. Prices rose $30/ton to reach $350/ton in January, followed by another increase to a new peak of $380/ton in August 1987. U.S. export shipments rose 5.4% to 2.3 million tons, and they were probably held back by linerboard availability. The strong market conditions continued in 1988, with linerboard mills still running at full capacity. Producers implemented another $30/ton price increase to $410/ton in March 1988, which resulted in record industry profitability. The average southern mill had an estimated pretax profit of nearly $110/ton in 1988 (including depreciation and interest). This followed an essentially break-even performance by the industry during the first half of the decade, with losses in 1982-83 and 1985.

Market conditions began to ease in 1989, and producers were unable to push through another $30/ton price increase to $440/ton in the spring because of strong resistance from independent converters, slower growth in corrugated box shipments, sluggish linerboard export demand, and increasing supply from a large number of incremental expansion projects under way. As a result, mill operating margins began to erode because of slippage in export prices, discounting later in the year on domestic prices, and gradual inflation in manufacturing costs. The squeeze has been most intense for linerboard mills on the West Coast, where woodchip costs more than doubled in 1989.

Corrugated box shipments continued to slow in 1990 with predictions that the U.S. may have entered a recession in the latter part of the year. Corrugated box shipments for all of 1990 were expected to be up by less than 1.0% from the previous year. Price discounting became more prevalent early in the year, and by about June, the transaction price for linerboard had slipped to around $360 to 370/ton. There was even more severe discounting on corrugating medium (see chapter on Corrugating Medium), and box prices began to erode gradually.

The linerboard market was brought into balance during

U.S. LINERBOARD INDUSTRY CONSOLIDATION

			Capacity of assets (000 tons)		
Year	Acquiring company	Selling entity	Un-bleached[1]	Total capacity	Price (million $)
1990	PCA/GE Capital[2]	Georgia-Pacific (two mills, 19 box plants)	830	830	$740[3]
1990	Georgia-Pacific	Great Northern Nekoosa	962	3,530	3,740
1988	Gaylord Container	Louisiana-Pacific (Antioch mill)	247	247	156
1987	Great Northern Nekoosa	Owens-Illinois (Forest Products Div.)	1,040	1,040	1,170
1987	Pratt Holdings	Georgia Kraft (Macon mill)	525	525	272[3]
1987	Stone Container	Southwest Forest Industries	440	960	766
1986	Mid-America Packaging	Crown Zellerbach (Gaylord Container)	716	716	260
1986	Stone Container	Jacksonville Kraft	490	490	112
1986	Jefferson Smurfit	Mobil (Container Corp. subsidiary)	1,270	1,903	1,139[3]
1986	Temple-Inland	Owens-Illinois (Orange mill and box plants)	400	400	228[3]
1986	Stone Container	Champion International (Brown Systems Group)	1,027	1,027	426
1985	Mid-America Packaging	Weyerhaeuser (Pine Bluff mill)	112	112	28
1985	Simpson	Champion International (Tacoma mill)	288	372	27
1984	Boise Cascade	Sonat (remaining 50% interest in Boise Southern)	340	652	195[3]
1984	Georgia-Pacific	St. Regis (Monticello mill and box plants)	578	578	375[3]
1983	Stone Container	Continental Group (Brown Systems Group)	1,315	1,315	509
	Total acquisitions completed and pending—16 transactions		10,580[3]	14,697	10,143[3]

1. Includes linerboard, corrugating medium, and kraft paper.
2. Pending. (GE Capital would buy mills and lease them to Purchasing Corp. of America.)
3. Includes timber assets.

Source: Morgan Stanley & Co., *Pulp & Paper.*

the summer months, however, by strong export demand, which, through August, was running about 15% ahead of a year ago. Mills ran at about 94% of capacity through the summer, and total containerboard inventories at the end of August were relatively normal at 2.58 million tons (5.6 weeks of supply). The relatively favorable market conditions combined with strong cost pressure from the surge in oil prices emboldened producers to announce a $30/ton price increase for Oct. 1, which would have taken the list price back to $410 in the eastern U.S. and $420 on the West Coast. Integrated producers also announced about a 9.5% increase on corrugated boxes. In addition, U.S. producers announced a $30/metric-ton price increase on linerboard in most export markets.

MAJOR U.S. LINERBOARD EXPANSION PROJECTS

Company	Mill location	Capacity (000 short tpy)	Startup date
Announced/completed			
Champion International	Roanoke Rapids, N.C.	50	1988
Georgia-Pacific	Monticello, Miss.	177	1988
Jefferson Smurfit	Fernandina Beach, Fla.	80	1988
Union Camp	Montgomery, Ala.	142	1988
Willamette	Campti, La.	50	1988
International Paper	Vicksburg, Miss.	83	1989
Macon Kraft	Macon, Ga.	107 R	1989-90
Temple-Inland	Orange, Tex.	90	1989
	Rome, Ga.	176	1990
Gaylord Container	Antioch, Calif.	140	1990
	Bogalusa, La.*	350	1990
Georgia-Pacific	Cedar Springs, Ga.	60	1990
Green Bay Packaging	Morrilton, Ark.	125 WT	1990
	Green Bay, Wis.	n.a.[1]	1990
Mead	Mahrt, Ala.*	160-185[2]	1990
Jefferson Smurfit	Jacksonville, Fla.	105	1990
Union Camp	Savannah, Ga.*	235 (net)[3]	1991
MacMillan Bloedel	Pine, Hill, Ala.	70	1991
Packaging Corp. of America	Counce, Tenn.	72	1991
Temple-Inland	Orange, Texas	WT [4]	1991
	Ontario, Calif.	70 R	1991
Stone Container (Seminole)	Jacksonville, Fla.	50 R[5]	1992
St. Joe Paper	Port St. Joe, Fla.	70	1993
Temple-Inland	Maysville, Ky.*	215 R	1993
Proposed			
Jefferson Smurfit	Fernandina Beach, Fla.	215[6]	1992
Weyerhaeuser	Valliant, Okla.	75	1992
	Springfield, Ore.	135	1992
International Paper	Gardiner, Ore./ Pineville, La.	240	1992-93
Dunkirk Containerboard	Dunkirk, N.Y.	250 R[7]	1992-93
Daishowa/Trans-Rim	Stockton, Calif.	350 R	1992-93
Kenaf of North America	Muskogee, Okla.	266 R	n.a.
Champion International	Roanoke Rapids, N.C.	(350)[8]	n.a.
Weyerhaeuser	Springfield, Ore.*	350	n.a.

*New machine or mill.
R = Mainly based on recycled fiber
WT = Will make white top.
n.a. = Not available.

[1] Rebuild of semichemical medium machine to make linerboard using recycled and nonkraft chemical fiber.

[2] New Mead machine is designed to produce 375,000 tpy of clay-coated kraft board (mainly for folding carton use), but initial production may be 40% to 50% linerboard.

[3] Net capacity increase after installation of new 460,000-tpy linerboard machine and shutdown of two older machines (one of which makes kraft paper).

[4] Machine will be rebuilt to produce 500 tpd of white-top liner.

[5] Kraft linerboard machine will be converted to 100% recycyled fiber; kraft paper machine will be shut down.

[6] Idle machine will be reactivated and converted to recycled liner and medium.

[7] Partnership which includes Domtar and about eight box converters.

[8] Champion eventually plans to convert liner and kraft paper machine to white paper.

Prospects for the increase holding, however, appeared to be uncertain because of resistance from independent converters and negative market psychology caused by fears of an impending recession. On the other hand, U.S. producers did appear to be at least partially successful in pulling up export prices, which in some markets had fallen considerably below average domestic levels on a mill net basis.

Nevertheless, the linerboard industry may be in for a difficult period if the economy begins to weaken further and producers are not able to offset higher energy costs. A number of key players in the market—such as Stone Container, Georgia-Pacific, and Gaylord Container—have debt loads exceeding 50% of equity. Analysts are mixed in regard to whether this will make the industry industry more disciplined about pricing or lead to greater competition as companies try to generate cash flow. Prices cannot erode much further before hitting break-even levels for some higher-cost linerboard mills. Average production costs for southern linerboard mills are probably now in the $315 to $325 range (including interest and depreciation).

CAPACITY TRENDS

The increasing pressure on profitability, however, is having the positive effect of slowing down industry capacity growth. The December 1989

American Paper Institute survey showed industry kraft linerboard capacity rising at a 3.5%/year rate over the 1990-92 period. With inclusion of two new recycled linerboard mill projects, total linerboard capacity (including recycled) was forecast to rise at a 4.5%/year rate. However, it is unlikely that either of these two projects will be completed before 1993—if they are built at all. In addition, the last survey included rebuild projects at two International Paper mills that would have added 240,000 tons of kraft linerboard capacity over the 1991-92 period, which also have been delayed. As a result, total linerboard (including recycled) capacity growth over the 1991-93 period will probably be closer to 3% to 3.5%/year.

In 1991, however, new capacity growth will be higher (3.9%), with the startup of three new unbleached kraft board machines. Gaylord Container in July 1990 started up a new 350,000-tpy linerboard machine at its Bogalusa, La., mill. Then last September, Mead Corp. started up a new 375,000-tpy coated kraft board machine at its Mahrt, Ala., mill (with about 40% to 50% of its initial production expected to be linerboard). In early 1991, Union Camp Corp. will be starting up a 460,000-tpy lightweight linerboard machine, although the net capacity addition is expected to be about 235,000 tpy because of the shutdown of an older linerboard machine and a kraft paper machine.

The era of constructing huge linerboard mills in the U.S. has passed because current linerboard prices are still below the level needed to justify the heavy investment required. In a 1989 speech, Roger W. Stone, chairman of Stone Container, estimated that it would cost $700 million to replace his company's 1,850-tpd linerboard mill in Florence, S.C. He said linerboard prices would have to be near $500/ton for the company to achieve a reasonable return on such an investment. The cost of the Florence mill converts to about $380,000/daily ton vs about $250,000/daily ton for a recycled mill. Because of these economic considerations, several companies are studying the construction of new recycled linerboard mills or the upgrading of older kraft mills.

Incremental expansion in vogue. A popular incremental expansion strategy is the installation of high-impulse or wide-nip presses accompanied by a wastepaper recycling line or debottlenecking of the kraft recovery system. High-pressure presses can add as much as 10% to 15% or more incremental capacity to an existing machine, and they can be installed relatively quickly.

One reason for higher-than-normal linerboard capacity growth in recent years has been widespread installation of such high-pressure presses on existing linerboard machines. This has caused a faster-than-normal upward "creep" in the U.S. industry's capacity base. For example, API's 1985 capacity survey projected total unbleached kraft paperboard capacity would reach 18.954 million tons by the end of 1988. The 1989 API survey estimated the figure at 20.269 million tons.

Historically, industry capacity has risen about 300,000 to 400,000 tons during the four-year span from when capacity is first estimated to when it becomes the base year of a new forecast, William Driscoll, API vice president for containerboard, has noted. During the 1985-88 span, capacity creep turned into a surge, jumping 1.32 million tons!

There is still considerable growth potential from such rebuilds, since nearly half of the approximately 80 unbleached kraft board machines in the industry could still be equipped with these presses. Such rebuilds could add more than 1.0 million tons to existing industry capacity. The remaining machines in the industry either have already had such presses installed or are believed to be unsuitable for such rebuilds. As previously noted, a number of mills are upgrading their machines by installing top formers to improve sheet quality. These projects also may add incremental capacity. About 17 U.S. linerboard mills have incremental capacity expansion projects under way that will add 50,000 tpy or more of capacity during the 1988-91 period.

Another potential source of additional linerboard capacity is the shift of swing machines away from kraft paper to linerboard production. The kraft paper market has declined since 1979 because of the penetration of plastic bags in the grocery sack market and sluggish shipments of multiwall sacks (see chapter on Packaging and Industrial Converting). Plastic bags have captured about 50% of the 25-billion-unit

HISTORY OF EASTERN U.S. CONTAINERBOARD PRICES, 1972-40

($/short ton)

Effective date of price changes	Linerboard (42-lb)	Semichemical medium (26-lb)
Sep. 1, 1972	$130.00	$123.00
Oct. 1, 1963	127.50	120.00
Apr. 1, 1962	122.50	115.00
June 15, 1961	114.75	—
Mar. 15, 1961	—	106.00
Nov. 15, 1961	—	110.00
Nov. 1, 1960	—	119.25
Apr. 1, 1956	127.50	132.50
Sep. 1, 1953	122.50	127.50
Jan. 1, 1951	117.50	122.50
Nov. 1, 1950	112.50	117.50
Aug. 1, 1950	105.00	110.00
May 17, 1949	100.00	105.50
Feb. 1, 1948	105.00	—
Mar. 1, 1947	—	110.75
Feb. 1, 1947	100.00	100.00
Sep. 1, 1946	—	82.50
Apr. 1, 1946	74.00	—
Oct. 1, 1945	66.00	—
Jan. 1, 1944	—	77.00
Apr. 1, 1943	63.00	74.00
Jan. 1, 1943	—	68.50
Nov. 1, 1941	—	60.00
July 1, 1941	60.00	57.50
May 1, 1941	55.00	—
Apr. 1, 1941	—	53.00
Jan. 1, 1940	52.50	50.00

Source: *Pulp & Paper Pricebook.*

U.S. PRICES FOR UNBLEACHED KRAFT LINERBOARD

(42-lb eastern U.S.)

Year	$/short ton	$/1,000 ft²
1990		
4Q	$370*	$7.77
3Q	370*	7.77
2Q	380	7.98
1Q	390	8.19
1989		
4Q	400*	8.40
3Q	400	8.40
2Q	410	8.61
1Q	410	8.61
1988		
4Q	410*	8.61
3Q	410	8.61
2Q	410	8.61
1Q	380	7.98
1987		
4Q	$380	7.98
3Q	350/380	7.35/7.98
2Q	350	7.35
1Q	350	7.35
1986		
4Q	320	6.72
3Q	310/320	6.51/6.72
2Q	280/290	5.88/6.09
1Q	260*	5.46
1985		
4Q	250/260	5.23/5.46
3Q	250/260	5.23/5.46
2Q	275	5.77
1Q	300/320	6.30/6.72
1984		
4Q	320/350	6.72/7.35
3Q	320	6.72
2Q	320	6.72
1Q	290/320	6.09/6.72
1983		
4Q	290	6.09
3Q	270/290*	5.67/6.09
2Q	270*	5.67
1Q	250*	5.25
Year end		
1982	250*	5.25
1981	270*	5.67
1980	270	5.67
1979	250	5.25
1978	220	4.62
1977	185*	3.89
1976	205*	4.31
1975	195	4.10
1974	195	4.10
1973	145	3.05
1972	130	2.73
1971	127.50	2.68
1970	127.50	2.68

*Indicates some discounting from transaction levels.

grocery bag market, and continued market penetration is expected. Unbleached kraft paper shipments have dropped from a peak of 3.93 million tons in 1979 to 2.68 million tons in 1989—a decline of 1.25 million tons. In 1990, shipments have been running nearly 10% below a year ago and may drop another 250,000 tons.

The majority of that capacity was shifted to white paper production by such companies as Champion International Corp., International Paper, and Georgia-Pacific—and some was permanently shut down. Part of that capacity, however, was shifted to linerboard production. About 11 swing kraft paper/linerboard machines are still in operation, accounting for about 13% of kraft linerboard production and 30% of kraft paper production. Any conversion of this swing capacity to full-time linerboard production would add proportionally more linerboard capacity because capacity increases an estimated 20% when paper production is converted to linerboard. Stone Container earlier this year announced plans to produce about 100,000 tpy of lightweight linerboard on No. 5 machine at its Hodge, La., mill, which had been permanently dedicated to kraft paper.

Greater use of high-performance linerboard may increase industry capacity if machines are able to increase production (based on surface area). However, some experts believe that industry capacity could actually be reduced as machines in the industry adjust to new standards based on

Footnotes for kraft linerboard price table

Zoned discounts. The eastern U.S. transaction prices shown above are generally before zoned rebates based on shipping distance from mills (most of which are located in the South). These discounts have typically been about $10/ton in some parts of the Midwest and $20 in the South. Producers in recent years have been trying to maintain a $10/ton upcharge on prices in the West Coast to reflect higher woodchip and other costs. Industry list prices as of Oct. 1, 1990 were generally raised to $410 in the eastern U.S. and to $420 on the West Coast.

Basis weight differentials. Based on the 42-lb eastern list price of $410 ($8.61/1000 ft²), upcharges for other weights of standard unbleached kraft linerboard are about as follows (with some possible slight variation among producers):

Weight	$/ton	$/1,000 ft²
26 lb	$465	$6.05
30	440	6.60
33	440	7.26
38	415	7.89
64	410	13.12
69	410	14.15
90	420	18.90

Specialty grades. List price for for 42-lb mottled white is around $525/ton ($11.03/1,000 ft²). List prices for other weights are around $585 for 33 lb and $490 for 69 lb. Wet strength grades typically sell at a $10-to-20$/ton upcharge over standard unbleached kraft linerboard.

compression strength rather than mullen. As noted at the beginning of this chapter, proposed changes to Rule 41 would permit that use of lighter-weight linerboard as long as it had the necessary compression strength. Even without formal changes in Rule 41, use of high-performance containerboard has grown because of the obvious cost savings. Also, many boxes do not have to comply with freight regulations, either because they are shipped by private or contract carriers or because of their design or end use (including half-slotted trays, produce boxes that carry their own certificates, meat and poultry boxes, and displays).

INDUSTRY RESTRUCTURING

The U.S. linerboard industry went through a major period of consolidation during the 1980s—reflecting the merger mania of the decade. Some large, diversified companies (Continental Group, Owens-Illinois Inc., and Mobil Corp.) with minor nonstrategic interests in the linerboard industry sold their operations. Other companies became available (St. Regis and Crown Zellerbach) because of attacks by corporate raiders. At the same time, some companies (Stone Container, Jefferson Smurfit Corp., and Gaylord Container) used leveraged financing techniques to take advantage of low asset values and to significantly expand their positions in the linerboard industry.

According to Thomas P. Clephane of Morgan Stanley & Co., about 8.8 million tons of containerboard/kraft paper capacity changed ownership (31% of total industry capacity) in 14 transactions during the 1983-88 period. Stone Container's multiple acquisitions included Continental Group's linerboard/kraft paper operations for $509 million, most of Champion International's unbleached mills for $426 million, Jacksonville Kraft for $112 million, and Southwest Forest Industries for $766 million. Jefferson Smurfit and a Morgan Stanley investment group acquired Container Corp. of America from Mobil for $1.14 billion. And Gaylord Container acquired the following: a kraft paper mill from Weyerhaeuser in 1985, the former Crown Zellerbach containerboard division in 1986, and Louisiana-Pacific's Antioch, Calif., mill in 1988.

Some major established paper companies also expanded their positions in the industry. Great Northern Nekoosa Corp. significantly increased its level of integration with containerboard mills and box converting plants when it purchased Owens-Illinois' Forest Products Div. for $1.17 billion in 1987. Major mill purchases were also made during the decade by Georgia-Pacific, Boise Cascade Corp., Temple-Inland, and Simpson Paper.

The only major foreign company investment in the U.S. linerboard industry was Pratt Pty Holdings' purchase of the former Georgia Kraft Co. mill in Macon, Ga., for an estimated $272 million. The Australian company also acquired about six box plants. The sale of the Macon mill was part of the dissolution of the Georgia Kraft joint venture between Temple-Inland and Mead. Temple-Inland purchased Georgia-Kraft's Rome, Ga., linerboard mill, and Mead purchased the Mahrt, Ala., mill to focus on producing coated kraft board. Another Australian company, Amcor Ltd., acquired Sunclipse Inc., a major southern California converter (Corru Kraft) and paper distributor, in 1989.

Many of the acquisitions were made at extremely attractive prices. For example, the cost for Stone Container's acquisitions was $137,000/daily ton of capacity for the Continental Group operations and $147,000/daily ton for Champion's unbleached mills. Smurfit/Morgan Stanley paid $212,000/daily ton for Container Corp. of America. (These figures include timber, box plants, and other paper/board grades in the total purchase price.) Improving industry profitability caused asset values to rise in the late 1980s. Great Northern Nekoosa paid close to $400,000/daily ton for its later acquisition of O-I's Forest Products Div., but this also reflected the quality of assets involved.

As a result of improved market conditions and aggressive cost cutting, the acquisition strategy of companies such as Stone Container and Jefferson Smurfit paid off dramatically. Smurfit estimated that it reduced CCA's expenses by $240 million in 1987-88. CCA's profit in 1988 reached about $128 million after taxes—up from only $30 to $40 million in 1984-85. From a break-even profit in 1985, Stone Container earned $342 million in 1988. In addition,

MANUFACTURING COST AND PROFITABILITY TRENDS FOR AVERAGE U.S. SOUTHERN LINERBOARD MILL

($/short ton)

	1990[1]	1989	1988	1987	1986	1985	1984
Average price[1]	$380	$405	$403	$361	$295	$274	$320
Fiber	120	114	107	103	98	106	113
Energy	25	23	23	24	24	32	34
Labor	38	37	36	36	36	35	35
Chemicals	16	15	14	14	14	15	15
Other	19	18	18	17	16	17	17
Delivery	36	34	33	32	32	32	32
Total variable costs	254	241	231	224	220	237	247
Depreciation	30	28	26	25	24	23	21
Interest	21	20	19	18	18	17	15
Overhead	18	17	16	16	16	15	15
Total costs[2]	323	306	292	283	278	292	299
Pretax profit[1]	57	99	111	78	17	(18)	21

Sources: 1. *Pulp & Paper* estimates. 2. Cost estimates from Resource Information Systems Inc. (RISI), World Kraftliner Study.

EXPORTS OF KRAFT LINERBOARD BY MAJOR SUPPLYING COUNTRIES

(000 short tons)

Country	1989	1988	1987	1986	% change 1989/88
U.S.	2,499	2,281	2,295	2,177	9.6%
Sweden	1,254	1,263	1,196	1,111	-0.7
Canada	249	323	311	347	-22.9
Finland	293	290	284	244	0.8
Brazil	301	448	234	208	-32.8
Portugal	177	132	126	149	34.3
France	166	138	138	n.a.	20.2
Austria	122	126	122	109	-2.7
Norway	73	60	55	42	22.6
Spain	29	37	43	39	-3.5
Total	5,170	5,098	4,804	4,564	1.4

n.a. = Not available.
Source: American Paper Institute—International Div., "Exports of Kraft Linerboard & Corrugating Material."

Stone Container acquired a foothold in the Canadian and European containerboard and corrugated box markets with its $2.2-billion acquisition of Consolidated-Bathurst Inc. in early 1989. But the latter acquisition now looks like a mistake because of the sharp downturn of the newsprint market and heavy debt load Stone incurred in the acquisition.

Merger activity has continued into the early 1990s with Georgia-Pacific's acquisition of Great Northern Nekoosa last spring. G-P announced plans to sell three of its containerboard mills at Tomahawk, Wis.; Valdosta, Ga.; and Toledo, Ore. Packaging Corp. of America and GE Capital announced plans to acquire the Tomahawk and Valdosta mills plus 19 box plants and some timberland for a total of $740 million. The mills would be sold to GE Capital, which would then lease them to PCA in what would be the largest such transaction ever.

Despite recent merger activity, the U.S. industry is still fragmented, with 21 individual linerboard producers. The five largest producers account for about 52% of U.S. linerboard capacity (vs 34% in 1980), and the ten largest have approximately 78% of the market (vs 58% in 1980). Stone Container, now the largest U.S. producer with a 14% market share, rose from No. 16 in 1980. Four new companies

U.S. KRAFT LINERBOARD EXPORTS BY WORLD REGION

(000 short tons)[1]

Year	Total[2,3]	Western Europe	Far East/ Oceania	People's Rep. China	Central America/ Mexico	South America	Caribbean/ other islands	Canada	Middle East	Africa
1988	2,499	635	692	247	378	191	63	74	141	76
1988	2,281	610	661	159	364	132	64	45	154	94
1987	2,295	597	633	284	275	123	56	44	145	91
1986	2,177	636	616	182	265	130	68	42	142	87
1985	1,807	511	460	110	250	122	56	40	137	107
1984	2,058	712	495	110	321	135	66	37	143	110
1983	2,255	761	501	166	276	110	74	48	151	108
1982	1,886	644	372	111	264	133	54	48	112	149
1981	1,973	637	357	174	275	131	48	39	127	185
1980	2,527	919	411	319	337	130	46	26	99	241
1979	1,645	711	264	11	278	110	45	55	101	70
1978	1,540	623	199	3	270	146	72	39	107	80
1977	1,428	607	120	22	238	133	67	30	118	93
1976	1,419	618	116	—	235	91	63	73	112	111
1975	1,224	522	73	—	171	121	38	65	142	91
1974	1,743	927	116	5	204	139	52	41	107	150
1973	1,646	862	141	17	237	138	43	19	79	108
1972	1,877	1,073	152	—	244	137	58	19	99	96
1971	1,966	1,166	142	—	247	148	44	17	100	101
1970	1,761	1,016	104	—	238	148	40	19	95	101

1. Includes "bleached" linerboard exports of 100,000 to 140,000 tons in recent years (most of this is believed to be unbleached mottled board that has been misclassified).
2. Totals may include some unallocated shipment not shown in regional breakdown; 57,000 tons were exported to the U.S.S.R. and eastern Europe in 1977.
3. Some variation exists between Dept. of Commerce and API production-for-export statistics, which were as follows (000 tons): 1989—1,903; 1988—2,296; 1987—2,303; 1986—2,246; 1985—1,830; 1984—2,086.
Source: American Paper Institute (from Dept. of Commerce data).

emerged among the ten largest producers during this time span, while six disappeared from the industry altogether.

The industry's level of integration probably has also increased in recent years as linerboard producers have tried to reduce their exposure to the cyclical board market by buying converting operations. Currently, the largest net sellers of linerboard to independent converters are International Paper, Great Northern Nekoosa, Union Camp, Stone Container, Macon Kraft, and Gaylord Container (with the completion of a major expansion program in 1990). Independent converters are in the difficult position of having to buy their raw material from their competitors in the box market but are surviving by skillful purchasing and serving market niches.

U.S. EXPORT LINERBOARD PRICES VS TESTLINER IN NORTHERN EUROPE

	U.S. kraft linerboard c.i.f., duty unpaid		Testliner no. 2 delivered Germany
Year	175 g + ($/metric ton)	+ 36 lb ($/short ton)	150 g (DM/metric ton)
1990			
3Q	$420/440*	$(381/399)	DM710/730
2Q	430/450*	(390/408)	770/800
1Q	440/460*	(399/417)	800/830
1989			
4Q	460/480*	(417/445)	800/830
3Q	480/490*	(435/445)	800/820
2Q	500	(453)	800/820
1Q	500	(453)	810/820
1988			
4Q	500*	(453)	790/820
3Q	515	(467)	750/780
2Q	530	(481)	640/720
1Q	485	(440)	660/680
1987			
4Q	485	(440)	650/670
3Q	485	(440)	650/670
2Q	440	(399)	640/660
1Q	405	(367)	610/630
1986			
4Q	405	(367)	620/650
3Q	370/405	(336/367)	660
2Q	370	(336)	700
1Q	290/310	(263/281)	700
Year end			
1985	270/290	(245/263)	750
1984	370/405	(336/367)	890
1983	333*	(362)*	720
1982	300*	(272)*	670
1981	415	(376)	780
1980	380	(345)	750/925
1979	375	(340)	770
1978	280	(254)	560
1977	230*	(209)*	—
1976	255*	(231)*	—
1975	310*	(281)*	—
1974	350	(317)	—
1973	245	(222)	—
1972	170	(155)	—
1971	137	(125)	—

*Some tonnage being sold below main transaction price levels.
Source: *Pulp & Paper Week.*

INTERNATIONAL MARKETS

The world linerboard market is estimated at around 40 million metric tpy—of which about 70% is kraft linerboard and the remainder is recycled board. World kraft liner exports total about 5 million tons annually—the largest suppliers being the U.S., Sweden, Canada, Finland, and Brazil. Kraft linerboard exports compete with locally produced recycled "test" linerboard in Western Europe and Asia. Only about 40% of the linerboard consumed in Europe is kraft linerboard, while the remainder is test and other recycled board.

Western Europe takes about half of all kraft linerboard exports, while the Far East is the next most important market. Nordic producers account for about 50% of the total kraft liner exports to Western Europe, while the U.S. mills supply slightly more than 20%. Other participants in the European linerboard export market include Portugal, France, Austria, Canada, South Africa, and the U.S.S.R. The U.S. is by far the most important linerboard supplier to the Far East and Latin America. In the last decade, the Pacific Rim (including China, Japan, and Oceania) has become the most important market for U.S. linerboard exports, rising from 16.7% in 1979 to 37.6% in 1989. Western Europe's share of U.S. linerboard exports has declined from 43.2% to 25.4% over the same period, according to API's International Div.'s annual report, *Exports of Kraft Linerboard and Corrugating Material.*

Supply/demand conditions in the large U.S. linerboard market have a major impact on price levels in the world linerboard market. That is because the large size of U.S. industry, which last year produced more than 16.4 million metric tons of linerboard and exported nearly 2.3 million metric tons. If there is excess supply in the domestic market, producers will try to boost export shipments if prices in overseas markets are favorable. This has the effect of taking some pressure off U.S. linerboard prices and, more importantly, protecting domestic box prices. However, the increased export activity—particularly by mills that are not regular suppliers—can wreak havoc on price levels in Western Europe and most Asian markets.

Export demand and exchange rate fluctuations can also have a major impact on the domestic linerboard market. Heavy initial purchases by the People's Rep. of China in 1980 spiked total U.S. linerboard exports to a record 2.29 million metric tons and helped keep the domestic market in balance. In 1985, however, the the strong dollar caused U.S. linerboard exports to slump to only 1.64 million tons. This contributed to an oversupply in the domestic market, which caused U.S. linerboard prices to collapse even though the U.S. economy was not in a real recession.

U.S. linerboard exports in 1989 rose 9.6% to 2.27 million metric tons, just short of the record 2.29 metric tons exported in 1980, according to Dept. of Commerce statistics (which include some bleached linerboard). With the weak U.S. dollar and stronger economic growth in many overseas countries, U.S. linerboard exports continued to grow in 1990 and were expected to hit a new record of about 2.6 million metric tons, up 17% from 1989. The strong export performance has been a major factor keeping the U.S. linerboard market in balance and prices stable in the second half of 1990, despite fairly sluggish U.S. economic growth.

Western Europe. Corrugated box shipments in Western Europe grew at a 6% annual rate over the 1986-89 period and have been growing faster than industrial production. European kraft linerboard consumption rose to nearly 3.6 million tons from 3.4 million tons in 1988. Imports into Europe from the Nordic countries declined 2.6% to 1.33 million tons. U.S. linerboard exports to Europe, however, rose 4.2% to nearly 576,430 tons. Imports from Brazil, which rose by 110,000 tons in 1988, dropped back down by about the same amount to about 179,160 in 1989.

U.S. linerboard exporters pushed through a $45/metric ton price increase in the spring of 1988, which brought the price of heavyweight (175+ g) linerboard to $525/metric ton c.i.f. (before duty). Prices had strengthened through 1986-87, after dropping below the minimum antidumping level of $333/metric ton—which made it difficult for U.S. producers to compete in the European Community on both economic and legal grounds. However, an attempt by U.S. producers to push through another $40/ton price increase in the spring of 1989 was unsuccessful, due to both some strengthening in the dollar and the failure of a domestic price increase.

European producers also were unsuccessful in raising their local currency list prices in Europe, which had also been in effect since the spring of 1988. The Nordic price for heavyweight linerboard in Europe was DM1,095/metric ton free-delivered or DM1,035 on a c.i.f. basis. U.S. linerboard export prices in Europe began to erode in the second half of 1989 as some U.S. mills tried to find a home for excess capacity in various export markets. Contract prices from U.S. suppliers had eroded down to the $[illegible]450/metric-ton c.i.f. range by late 1989, and even lower spot prices were being offered (particularly in southern Europe). Prices continued to erode gradually in 1990 and, by early fall, were down to about $420 to $430/metric ton in northern Europe and the U.K.

U.S. producers announced a $30/metric ton price increase for the fourth quarter of 1990, which was expected to be fairly successful because of the weak dollar and slower but still healthy demand in most markets, with the exception of the U.K. European producers were forced to lower their local currency prices because of the weak dollar and influx of low-price U.S. board, even though demand remained relatively strong. Prices in Germany dropped to about DM820 to DM850 free-delivered by early fall, which, adjusting for DM60/ton delivery, were equal to about DM760 to DM790/metric ton c.i.f., or about $490 to $500. This would compare with the U.S. price of around $450 after a 6% duty, a larger than normal gap.

The future outlook for European linerboard demand should be relatively bright (except for an expected slowdown in 1991), while growth in kraft liner capacity will be restrained. Growth in European corrugated box demand should be helped by higher growth rates resulting from political unification in 1992 and the opening of eastern Europe. Per capita corrugated box consumption is considerably lower in Europe than the U.S. (36 kg vs 74 kg), and changes in the European distribution will create more need for corrugated material for shipping over longer distances, Anders Haglund, president of ASSI Kraftliner, told *Pulp & Paper*'s Fourth International Unbleached Kraft Conference in New Orleans, La., in November 1990.

U.S. EXPORT LINERBOARD PRICES IN ASIA

Year	Southeast Asia 125 g ($/metric ton c.i.f.)[1]	People's Rep. China ($/metric ton f.a.s.)[2]	Japan 175 g+ ($/metric ton c.i.f.)[3]	Japan Domestic K_2 (¥/kg delivered)[4]
1990				
3Q	$510	$350	$400	¥75
2Q	510	350	400	75
1Q	510	350	400	75
1989				
4Q	510	355	400/425	75
3Q	530	360	425	75
2Q	530/540	350	425	75
1Q	520/530	350	425	78
1988				
4Q	520/530	351	450	78
3Q	550/570	355	450	78
2Q	550/570	361	450	78
1Q	530	n.a.	n.a.	n.a.
1987				
4Q	530	422	450	¥80
3Q	500/530	391	420/450	80
2Q	500	367	420	80
1Q	485/500	358	390	78
1986				
4Q	440/455	332	380	75
3Q	420/435	308	370	80
2Q	350	219	350	85/87
1Q	280	203	320	85
Year end				
1985	270*	208	—	85
1984	380	326	—	124/125
1983	365	222	—	118/120
1982	—	207	—	119/129
1981	—	280	—	133/140
1980	—	326	—	137

n.a. = Not available.

1. Levels in Hong Kong typically $10/ton lower due to freight cost.
2. Average value per ton of exports calculated from Dept. of Commerce data; 1990 estimated.
3. Prices from regular U.S. suppliers.
4. K_2 contains about 40% wastepaper and has become the most important liner grade made by Japanese mills.

Source: *Pulp & Paper Week.*

European (including Nordic) kraft linerboard capacity is expected to rise at a 3%/year rate from 2.77 million tons in 1989 to 3.11 million tons in 1993. Capacity for test linerboard will probably show somewhat higher growth with the startup of several new machines and growing environmental interest in recycling. Production of display or white linerboard grades has been growing rapidly in Western Europe. Capacity of mottled and white-top linerboard is expected to grow from about 565,000 tons in 1989 to 785,000 tons in 1993—an 8.6% average annual rate, according to API.

Pacific Rim. The rapidly growing countries of the Far East and Oceania are becoming an increasingly important market for kraft linerboard exports. Exports from the U.S., the dominant supplier to the region (including People's Rep. China), rose 14.6% to 852,146 tons in 1989. This performance was helped by a 55% jump in exports to People's Rep. China to 224,000 tons. Exports to Taiwan and Rep. Korea were down in 1989. These countries, together with Indonesia, have practically doubled their domestic test liner capacity over the past several years. Exports to Hong Kong, the second largest importing country in the region (and a transshipment point to China), rose 21.8% to nearly 197,000 tons in 1989.

Prices in the region tend to be volatile because some U.S. mills use it as a dumping ground during periods of domestic oversupply. For example, as irregular sellers entered the market with low spot offers in 1985, price levels for lightweight linerboard dropped to between $260 to $270/metric ton c.i.f. Prices staged a strong recovery during the next two years, and by the spring of 1988, U.S. producers announced new list prices of $560 to $570/ton for lightweight ($515 to $525 for heavyweight) for countries such as Singapore, Malayasia, Hong Kong, and Taiwan. Prices began to erode in the second half of 1988 and, by early 1990, were down to $500 to $510 ($450 to $460 for heavyweight). U.S. producers appeared to be successful in pushing through about a $30/ton price increase in fall 1990, which would take price levels up to about $530 to $540.

WESTERN EUROPE'S KRAFT LINERBOARD SUPPLIERS

(000 short tons)

	1989	1988	1987	1986	1985
Sweden	1,133	1,170	1,115	1,035	1,040
Finland	261	275	254	226	194
Norway	69	58	45	35	19
Total Nordic	1,463	1,503	1,413	1,295	1,253
U.S.	635	610	597	636	511
Canada	128	157	139	133	105
Austria	118	121	117	103	95
Iberia	208	166	164	182	178
France	147	130	128	118	86
Brazil	197	308	186	156	108
U.S.S.R.	n.a.	47	105	86	19
South Africa	n.a.	89	65	69	15

n.a. = Not available.

Japan. Despite Japan's healthy economic growth and government policy aimed at increasing imports, linerboard exports to that country have been declining for several years. U.S. exports dropped 6.4% to 139,000 tons in 1989. The Japanese market has suffered from domestic overcapacity, and the price of K2 linerboard (the most common grade, containing about 40% wastepaper) has flattened or declined for several years, despite healthy corrugated box production. This keeps pressure on export prices, making Japan a less-attractive market for U.S. suppliers. The price of heavyweight kraft linerboard in Japan has fallen below that of other major export markets.

Prices in the Japanese market tend to be more stable because of special quality requirements and long-term business relationships that make it difficult for spot sellers to enter the market. Weyerhaeuser set up a warehouse system and sells liner in yen delivered to Japanese customers. According to *Japan Pulp & Paper* magazine, in 1988 the largest North American linerboard exporters to Japan were Weyerhaeuser (80,000 metric tons), International Paper (40,000 tons), Eurocan Pulp & Paper Co. (34,000 tons), and Stone Container (25,000 tons).

U.S. linerboard exports to Japan are expected to increase because of uncompetitive production costs in that country resulting from high fiber and energy costs. In addition, Japanese linerboard mills are currently running at full capacity, with estimated 1990 operating rates reaching the 95% to 99% range—up from as low as 70% in the mid-1980s—and no significant new capacity planned. As a result, Japanese linerboard imports (which totaled 173,000 metric tons from all sources in 1988) could expand significantly in the early 1990s, and U.S. suppliers would be the main beneficiaries. However, Taiwan could emerge as an important supplier of test liner to Japan.

People's Rep. China. The wild card in the U.S. linerboard export picture is People's Rep. China, which in some years was the single-largest importing country. U.S. shipments in 1987 increased 54% to 258,000 tons—second only to the record 289,000 tons shipped to that country in 1980, when it began making major purchases. Since then, People's Rep. China has bought in surges, with shipments during the weakest years dropping to around 100,000 tons. These surges reflect the country's inventory cycles and its attempts to buy at the lowest prices in the U.S. market.

Orders from People's Rep. China fell off in the second half of 1987 and remained weak through first-half 1989. Despite the civil unrest that paralyzed the country in mid-1989, exports in 1989 rose to 224,000 tons. Exports will probably show growth again in 1990, although prices have been low at around $350/metric ton ($317/short ton) f.a.s. U.S. suppliers tried to raise prices to Chinese buyers by about $30/ton in the fall of 1990 but have been meeting strong resistance.

The long-term outlook for U.S. linerboard exports to People's Rep. China is positive because of eventual revival of that country's strong economic growth, its drive to increase exports, and its limited wood resources. Most of the kraft linerboard imported into People's Rep. China is used for packaging export products. The country imports linerboard through China Pack and Ministry of Light Industries. International Paper is believed to be the largest U.S. exporter to China.

Latin America. U.S. linerboard exports to Latin America rose 13.0% in 1989 to 575,095 metric tons. Mexico and Central America represent the largest market, and exports to these countries increased 4.1% to to nearly 343,287 tons. Exports were expected to grow in 1990 with economic reforms in Mexico and removal of trade sanctions against Panama and Nicaragua. However, startup of a 250,000-tpy recycled linerboard machine by Grupo Durango in 1989 might hold back exports to that country despite growing demand from the burgeoning maquiladora industries along the U.S. border. Costa Rica is the largest importing country, purchasing 118,000 tons of U.S. linerboard in 1989.

Shipments to South America surged 45.4% to 173,950 tons, with Ecuador and Colombia accounting for most of U.S. exports. A number of countries in the regions, such as Argentina, Venezuela, and Chile, are relatively self-sufficient in linerboard, while Brazil is a major linerboard exporter (273,500 tons in 1989), but hardly any of this went to neighboring countries. Klabin, the largest producer in Brazil, plans to install a new export-oriented machine with capacity of around 200,000 metric tpy for completion in 1992. (This will replace some existing capacity for a net gain of about 50,000 tpy). Several U.S. companies, including Jefferson Smurfit, Stone Container, and Union Camp, operate containerboard mills or box plants in the region, which also stabilizes prices.

The U.S. is the only foreign supplier of any consequence to these markets. With its economy and domestic consumption declining in 1988, Brazil increased its kraft linerboard exports by more than 90% to a record 448,000 short tons, yet only a small portion was exported to other Latin American countries. In the future, countries such as Brazil, Chile, and New Zealand—each with large, fast-growing softwood resources—will probably be big competitors in the linerboard export market.

OUTLOOK

The U.S. linerboard industry in late 1990 was probably near the bottom of the downturn that began in the second half of 1989. Assuming the U.S. economy does not fall into a serious recession, box shipments will probably show about 1% growth in 1990 and 2% growth in 1991 as the U.S. economy begins to pick up later in the year.

Linerboard exports were expected to jump about 15% in 1990 and may grow as much as 5% in 1991, due to continuing economic growth in many countries of Europe and Asia. U.S. linerboard mill operating rates are expected to remain around 93% in 1991, even though capacity next year is expected to grow at around 3.9% with the startup of the new Gaylord, Mead, and Union Camp machines.

Prices will probably not erode much through the seasonally slow winter period, since the weak U.S. dollar will help put a floor under domestic pricing. Any excess linerboard production will be shipped overseas, especially after last fall's rise in linerboard export prices. Producers will probably be successful in raising linerboard prices close to the former $410/ton level by the spring of 1991. Customers should accept the increase as greater confidence in the economy returns and because the industry will have gone three years without a price increase. This will cause converters to begin rebuilding inventories and will help production levels. The market should continue to firm the following year, with no new linerboard machines (kraft or recycled) scheduled to start before early 1993.

The longer-run outlook for the U.S. linerboard industry is favorable for several reasons: low production costs relative to other parts of the world, increasing industry concentration, introduction of higher-value-added products, and lack of strong competition from plastics or other competing packaging materials. U.S. linerboard exporters, however, could face stiffer competition in world markets from nontraditional kraft linerboard producers such as Brazil, Chile, New Zealand, and South Africa, as well as from local test liner suppliers. (For a long-term supply/demand forecast, see *Containerboard and Corrugated Containers Market Outlook to the 21st Century*, written by Kenneth E. Lowe and published by *Pulp & Paper* Forecaster Services.)

1989 KRAFTLINER EXPORTS FROM MAJOR PRODUCING COUNTRIES

(000 tons)

	Exporters					
Major importers	**U.S.**	**Canada**	**Sweden**	**Finland**	**Norway**	**Brazil**
Austria	1	—	17	4	—	—
Belgium	8	76	64	9	5	11
Denmark	—	—	76	23	1	2
Finland	4	—	33	—	—	1
France	13	—	125	25	—	5
Germany, Dem. Rep.	—	—	—	7	—	—
Germany, Fed. Rep.	95	2	197	65	24	43
Greece	5	—	10	3	—	9
Iceland	1	—	—	—	—	—
Ireland	2	—	40	6	1	—
Italy	120	—	69	5	—	71
Netherlands	38	—	74	20	9	9
Norway	—	—	29	—	—	—
Portugal	3	—	—	—	—	—
Spain	52	—	1	12	—	—
Sweden	5	—	—	6	—	—
Switzerland	—	—	28	5	2	1
U.K.	227	36	255	51	21	25
Yugoslavia	-	—	—	—	—	1
Other Europe	1	2	16	3	—	—
Total Europe	574	142	1,034	244	63	178
Canada	67	—	—	—	—	—
U.S.	—	35	—	—	—	—
Total North America	67	35	—	—	—	—
Australia	13	—	1	—	—	11
China, People's Rep.	224	5	30	—	—	—
Hong Kong	197	4	1	—	—	10
Indonesia	11	-	—	—	—	—
Israel	63	—	6	—	—	—
Japan	139	34	—	—	—	—
Jordan	2	—	—	—	—	3
Korea, Rep.	42	14	—	—	—	—
Kuwait	2	—	—	—	—	2
Lebanon	4	—	—	—	—	4
Malaysia	41	4	1	3	—	—
Philippines	92	5	3	—	1	—
Pakistan	—	—	—	—	—	2
Saudi Arabia	46	—	—	—		3
Singapore	44	3	6	3	—	-
Taiwan	42	3	—	—	—	—
Thailand	5	—	—	—	—	—
Turkey	—	—	—	3	—	8
United Arab Emirates	8	—	—	—	—	6
Other Asia/Australasia	5	1	23	7	2	2
Total Asia/Australasia	983	74	71	16	3	51
Brazil	2	—	—	—	—	—
Chile	2	—	—	—	—	8
Colombia	64	—	—	—	—	—
Costa Rica	118	—	—	—	—	—
Dominican Republic	10	—	—	—	—	—
Ecuador	102	—	—	—	—	—
El Salvador	11	—	—	—	—	—
French West Indies	8	—	—	—	—	—
Guatemala	37	—	—	—	—	—
Honduras	47	—	—	—	—	—
Jamaica	10	—	—	—	—	—
Mexico	80	—	—	—	—	—
Panama	51	—	—	—	—	—
Trinidad and Tobago	1	—	—	—	—	—
Venezuela	2	—	—	—	—	—
Other Latin America	7	1	4	—	—	4
Total Latin America	574	1	4	—	—	12
Egypt	35	—	—	—	—	4
Ivory Coast	17	—	—	—	—	—
Morocco	—	—	13	—	—	—
Nigeria	4	—	2	—	—	9
South Africa	4	—	—	—	—	—
Other Africa	8	—	15	5	—	19
Total Africa	69	—	29	5	—	32
WORLD TOTAL	2,268	226	1,138	265	66	261

Source: Pulp & Paper International, Annual Review, July 1990.

Paperboard:

CORRUGATING MEDIUM

Corrugating medium is used to form the central or middle fluting material in corrugated containerboard. It is first fluted or corrugated in a corrugator, then faced on both sides with linerboard to form the rigid combined board.

Corrugating medium is made from both semichemical pulp and recycled fiber. In 1989, about 75% of U.S. corrugating medium was made from semichemical pulp furnish (which typically contains some recycled fiber). The remaining 25%, called "bogus" medium, was produced from 100% recycled fiber. Basis weights of corrugating medium are 22, 26, 31, 33, 36, and 40 lb/1,000 ft².

U.S. STATISTICS FOR CORRUGATING MEDIUM

(000 short tons)

	1990e	1989	1988
Production			
Semichemical	5,720	5,692	5,668
Recycled	1,860	1,785	1,824
Total	7,580	7,477	7,492
Capacity			
Semichemical	6,003	5,917	5,788
Recycled	2,197	2,040	1,947
Utilization rates, %			
Semichemical	95.3	96.2	97.9
Recycled	84.7	87.5	93.7
Imports[1]	165	143	129
Exports	145	138	141
Apparent U.S. consumption			
000 tons	7,600	7,482	7,480
lb/capita	60.8	60.1	61.0
000 tons/billion $ real GNP	1.80	1.80	1.86

e = Estimate.
1. Dept. of Commerce, CPPA.
Sources: American Paper Institute, *Pulp & Paper* estimates.

Semichemical corrugating medium is made primarily from hardwoods (although some mills find it difficult to pulp certain species, such as white oak). Western mills sometimes use softwood species. Softwood sawdust is also used. Semichemical medium is normally manufactured on conventional fourdrinier paper machines, but a small percentage is produced on cylinder board machines. A couple of mills in Wisconsin and Virginia produce medium using twin-wire formers.

Semichemical medium contains some long fiber to improve paper machine runability and to lessen the tendency of medium to crack and break upon corrugating. The principal sources of long fiber are waste corrugated containers and new double-lined kraft cuttings. The amount of secondary fiber used varies from 0% to 50%, but average wastepaper content is close to 33% (even though the American Paper Institute still defines "semichemical medium" as containing no less than 75% virgin woodpulp). In some cases, screenings from kraft mills or kraft softwood pulp are used as the source of long fiber.

Semichemical pulping combines a mild chemical pulping of chips prior to mechanical defibrating and produces a fairly high yield—60% to 80%—as well as an intermediate-strength level. Neutral sulfite semichemical (NSSC), developed in the 1920s, was the original semichemical pulping process. Sodium sulfite and soda ash were used, and pulping was initially performed using rotary batch digesters. Most semichemical mills now use continuous digesters, and they have shifted from NSSC to the newer carbonate-base and green-liquor semichemical pulping processes.

More than 60% of U.S. semichemical mills have shifted from NSSC to the Owens-Illinois Inc. nonsulfur and green-liquor processes. These processes, developed since the 1960s, are simpler and less capital-intensive, and they have fewer pollution problems. The O-I process uses soda ash (sodium carbonate) and a small amount of caustic soda, and it is adaptable to existing stand-alone semichemical mills with only minor equipment modifications.

Green-liquor semichemical pulping uses kraft green liquor; therefore, the process can be used only in combination with a kraft mill. Such cross-recovery reduces chemical processing and recovery and minimizes capital costs. Both the O-I and green-liquor processes produce a semichemical pulp comparable in quality to NSSC, except for a darker color. Wetting agents, however, must be added to the refined stock to control glue absorption in the finished board.

Mills that produce bogus medium use mostly old corrugated containers (OCC) as a fiber source. Because waste corrugated containers contain foreign materials (tape, hotmelts, latexes, asphalt, waxes, etc.), mills use cleaning equipment to remove contaminants from the stock. Additives such as modified starches and gums are used to improve the strength, or concora, of bogus medium. At 5 to 10 lb/ton, these additives can improve concora by 10% to 20%.

The principal test used to judge the strength of corrugating medium is the concora test. Concora is controlled by refining and through choice of fiber types. Typical concora values for standard basis weights are 60 to 70 lb for 26-lb medium and 70 to 90 lb for 33-lb medium.

Most semichemical medium is produced at 26 lb/1,000 ft^2, but the trend is toward heavier weights. Weights of 36 to 40 lb and higher now account for about 8% of total semichemical production—up from virtually nothing at the beginning of the 1980s. This reflects an industry move toward more performance-oriented corrugated packaging that emphasizes top-to-bottom compression strength in finished boxes. (See Linerboard and Converted Products chapters.) Compression strength requirements can be met using lower-basis-weight linerboard as well as heavier-weight corrugating medium, resulting in reduced fiber costs.

Wet-strength grades have grown in popularity (mainly in 33-, 36-, and 40-lb weights) and now account for about 5% of semichemical medium production. Corrugating medium for conventional uses is not sized. Hard sizing would interfere with starch gluing and result in poor adhesion between liner and medium.

The U.S. has 38 semichemical medium mills, and approximately one-third of total industry capacity is located in the upper Midwest hardwood region. Most Canadian capacity is located in the eastern and Maritime provinces, and some of these mills ship to the northeastern U.S. Recycled medium mills are usually located in major urban areas, near wastepaper supplies and major box markets, giving them an advantage in transportation costs.

INDUSTRY STRUCTURE

The corrugating medium market tends to be overshadowed by the larger linerboard market and is more competitive and regionalized. A larger number of players are in the medium market, even though U.S. production is less than half that of linerboard. More than 36 companies in the U.S. produce semichemical and recycled medium on about 44 machines of varying capacity, trims, and product quality. By contrast, 21 companies are producing linerboard on about 52 machines. Recycled medium has increased its total share of the U.S. medium market from about 23% in 1987 to nearly 27% by 1990. The growing importance of recycled medium and the increasing use of recycled fiber in semichemical medium will increasingly link medium to the vicissitudes of the wastepaper market. Another difference with linerboard is that only about 2% of semichemical medium is exported (vs 13% for linerboard), while imports

ANNUAL U.S. CAPACITY FOR CORRUGATING MEDIUM

(000 short tons)

Year	Semichemical	Recycled[1]	Total	Change (%)
1992e	6,220	2,270	8,490	3.0%
1991e	6,010	2,236	8,246	0.6
1990e	6,003	2,197	8,200	3.1
1989e	5,917	2,040	7,957	2.9
1988	5,788	1,947	7,735	5.0
1987	5,682	1,685	7,367	3.2
1986	5,557	1,580	7,137	2.9
1985	5,411	1,523	6,934	2.3
1984	5,252	1,524	6,776	1.0
1983	5,156	1,555	6,711	0.4
1982	5,207	1,478	6,685	5.5
1981	4,988	1,349	6,337	1.0
1980	4,946	1,330	6,276	0.3
1979	4,864	1,392	6,256	2.8
1978	4,739	1,343	6,082	1.4
1977	4,661	1,337	5,998	-3.8
1976	4,758	1,476	6,234	4.2
1975	4,536	1,449	5,985	3.5
1974	4,430	1,358	5,788	4.0
1973	4,386	1,178	5,564	6.6
1972	4,155	1,063	5,218	5.6
1971	3,938	1,000	4,938	2.2
1970	3,847	983	4,830	—

e = Estimate.

[1] Shutdowns of Nolichucky Industries and Clinch River Corp. not included.

Sources: American Paper Institute, *Pulp & Paper* estimates.

(mainly from Canada and Mexico) play a larger role in the U.S. market.

The cost profiles of corrugating medium producers show greater range, reflecting wider variation in mill size and fiber furnish costs. About one-third of U.S. semichemical medium capacity is represented by machines that produce 125,000 tpy or less. Two U.S. semichemical machines have capacity to produce over 300,000 tpy each. Nekoosa Packaging Inc.'s Tomahawk, Wis., mill and Mead Corp.'s Stevenson, Ala., mill are two of the most efficient medium mills. Recycled mills tend to be older and less efficient, but they may have an advantage when wastepaper costs are low. In 1975, Inland Container Corp. built the first large new recycled medium mill in the U.S. since the 1930s in Newport, Ind., and the mill currently has capacity to produce about 250,000 tpy.

Georgia-Pacific Corp. was the largest producer of corrugating medium in 1990 after the acquisition of Great Northern Nekoosa Corp. However, G-P plans to sell its 445,000-tpy Tomahawk, Wis., mill to Packaging Corp. of America by the end of the year. As a result, Stone Container Corp. will become the largest medium producer, with total capacity of about 920,000 tpy, followed by G-P (with 830,000 tpy), although that company has also been trying to sell its Toledo, Ore., mill (which has about 190,000 tpy of medium capacity). Weyerhaeuser Co. (730,000 tpy) and Packaging Corp. of America (725,000 tpy with the Tomahawk mill) would come next in size. One major medium mill, Virginia Fibre Corp. (265,000 tpy), has no box plants and sells exclusively to the independent converters. And one major integrated linerboard producer, Union Camp Corp., has no medium mills.

CURRENT MARKET CONDITIONS

The U.S. corrugating medium market has become increasingly competitive since the second half of 1988 due to slower growth in U.S. corrugated box shipments, substantial new capacity additions in recycled medium capacity (combined with a sharp drop in wastepaper costs), and increased competition from imports.

Growth in U.S. shipments of corrugated boxes—the main end use for medium—declined from 3.6% in 1988 to 1.6% in 1989 and less than 1.0% in 1990. As a result, total U.S. medium production grew 4.0% in 1988 but then declined 0.2% in 1989 and was expected to be up about 1.3% last year. Operating rates for semichemical medium mills have declined from nearly 98% in 1988 to about 95% in 1990. Operating rates for recycled mills, however, dropped from nearly 94% in 1988 to an estimated 85% last year, reflecting substantial capacity additions. This decline in operating rates was accompanied by a roughly 40% decline in the cost of OCC from mid-1988 to mid-1989.

The new capacity in recycled medium combined with sharply lower OCC costs has probably been the most important factor behind the recent weakness in medium prices. Prices on medium were last increased in March 1988, when the list price for 26-lb semichemical medium was raised by $30/ton to $400. Transaction prices, however, began to ease in the second half of 1988 and, by the fourth quarter of 1989, had reached about $350 to $360/ton in the eastern U.S. Prices continued to decline through the second quarter of 1990, dropping to about $320 in the eastern U.S. and then stabilizing. The lowest prices were reported in the Northeast ($310 to $320), with somewhat higher levels in parts of the Midwest and South ($320 to $330) and the more isolated West Coast ($340 to $350).

In fall 1990, some producers announced a list price increase to $350 for semichemical medium and to $340 for recycled medium for Oct. 1. But there was doubt producers would get much immediate relief, despite relatively high operating rates for semichemical medium mills. Imports of low-price medium from Canada and Mexico have added to competitive market conditions in the northeastern and southwestern U.S. Imports of medium into the U.S. will have in-

ANNUAL U.S. PRODUCTION OF CORRUGATING MEDIUM

(000 short tons)

Year	Semichemical	Recycled	Total	Change (%)
1989	5,692	1,785	7,477	-0.2%
1988	5,668	1,824	7,492	4.0
1987	5,598	1,607	7,205	3.8
1986	5,373	1,568	6,941	5.5
1985	5,088	1,486	6,574	0.1
1984	5,169	1,397	6,566	4.6
1983	4,731	1,545	6,276	7.9
1982	4,389	1,427	5,416	3.6
1981	4,717	1,315	6,032	0.5
1980	4,723	1,281	6,004	0.2
1979	4,689	1,301	5,990	2.4
1978	4,439	1,408	5,847	5.4
1977	4,264	1,286	5,550	7.8
1976	4,105	1,040	5,145	14.6
1975	3,702	788	4,490	-15.1
1974	4,175	1,115	5,290	-3.2
1973	4,260	1,204	5,464	10.3
1972	4,010	942	4,952	8.1
1971	3,700	879	4,579	3.7
1970	3,500	916	4,416	—

Sources: American Paper Institute, *Pulp & Paper* estimates.

CAPACITY RANKINGS OF U.S. CORRUGATING MEDIUM PRODUCERS

(000 short tons)

	Company	Annual capacity: Semichemical medium	Annual capacity: Recycled medium	Annual capacity: Total	Capacity share (%)
1.	Georgia-Pacific	1,275[1,4]	—	1,275	19.5%
2.	Stone Container	685	235	920	11.2
3.	Weyerhaeuser	730	—	730	8.6
4.	Temple-Inland	240	305	545	6.5
5.	Jefferson Smurfit/CCA	120	405	525	6.4
6.	Mead	380	—	380	4.6
7.	International Paper	365	—	365	4.5
8.	Willamette Industries	145	160	305	3.7
9.	Packaging Corp. of America	280[1]	—	280	3.4
10.	Virginia Fibre	265	—	265	3.2
11.	MacMillan Bloedel	250	—	250	3.0
12.	Menasha	185	—	185	2.2
13.	Green Bay Packaging	185[2]	—	185	2.2
14.	Weston Paper	155	—	155	1.9
15.	Waldorf	—	145	145	1.8
16.	Chesapeake	—	135	135	1.6
17.	Manville Forest Products	130	—	130	1.5
18.	Boise Cascade	110	—	110	1.3
19.	Groveton Paper Board	105[3]	—	105	1.3
20.	Westvaco	100	—	100	1.3
21.	Gaylord Container	—	95	95	1.2
22.	Grief Board	—	85	85	1.0
23.	Sonoco Products	85	—	85	1.0
24.	Clinch River	—	—[5]	—	—
25.	Corrugated Services	—	80	80	1.0
26.	Longview Fibre	—	—	80	1.0
27.	Consolidated Packaging	80	—	75	0.9
28.	Jackson Paper (Dixie Container)	75	73	73	0.9
29.	Cascades	—	70	70	0.9
30.	Fairfield Paper	—	70	70	0.9
31.	Visy Board	—	55[6]	55	0.5
32.	Connelly Containers	—	45	45	0.4
33.	Newark Boxboard	—	35	35	0.4
34.	Interstate	—	30	30	0.4
35.	Cleaners Hanger	—	30	30	0.4
36.	Menominee Paper (Bell Fibre)	—	25	25	0.3

U.S. capacity (1990): 8.20 million short tons (semichemical and recycled)
Market share of top five companies: 48.7%
Market share of top ten companies: 68.2%

1. Includes former Great Northern Nekoosa mills at Tomahawk, Wis., and Toledo, Ore (445,000 tpy and 192,000 tpy of semichemical capacity); G-P then reached an agreement to sell Tomahawk and Valdosta, Ga., liner mill to Packaging Corp. of America.
2. May include some recycled linerboard, which Green Bay plans to begin producing in late 1990.
3. Owned 31% by Jefferson Smurfit and 69% by SPB Canada; machine operated by James River.
4. Reflects 50% interest in 170,000-tpy semichemical medium machine jointly owned by Georgia-Pacific and Sonoco Products at the latter's Hartsville, S.C. mill; G-P markets output.
5. Semichemical mill in Harriman, Tenn., currently idle after shutdown due to financial problems in early 1990; sold to Addington Environmental Inc., which plans to convert mill to producing 250 tpd of recycled medium.
6. Mill began production in early 1990; owned by Pratt Group of Australia.

creased to about 165,000 short tons in 1990 from just under 130,000 tons in 1988. Exports of U.S. medium (mainly to Central America and the Caribbean) have been relatively flat at around 140,000, and prices have been low.

For many years, semichemical medium sold at a $10 differential to kraft linerboard. Producers, however, were unable to restore this differential after the 1985 industry downturn, in which semichemical medium prices dropped to about $230 to $240/ton (opening about a $20 to $30 gap with linerboard, which more recently increased to $40 to $50 in the eastern U.S.). One reason for the large differential is the growing presence of recycled medium and the low cost of secondary fiber. Another reason is that, unlike linerboard, medium is not getting any support from stronger export demand due to weakness in the dollar. Recycled medium typically sells for about $10/ton less than semichemical medium.

CAPACITY TRENDS

Higher-than-normal capacity growth for corrugating medium, particularly recycled, has been a major factor behind the current market weakness. Total U.S. corrugating medium capacity rose at a 3.7%/year average rate over the 1987-89 period, with recycled medium capacity shooting up close to 9%/year. Recycled medium capacity jumped from 1.69 million tons in 1987 to 2.04 million tons in 1989. Growth in semichemical medium capacity was more moderate, rising 2.1%/year over the same period, according to the 1989 API capacity survey.

The growth in semichemical medium capacity has come from rebuilds of existing machines. These projects have sometimes included installation of wide-nip presses to add incremental production and improve product quality. The growth of recycled medium capacity has also reflected machine rebuilds, although Cascades Inc. converted an idle Niagara, N.Y., tissue mill to recycled medium production in 1988 and Visy (part of the Pratt Group of Australia) started up a small recycled mill built with used equipment at Hartford City, Ind., in early 1990. Gaylord Container shifted about 80,000 tpy of semichemical to 120,000 tpy of recycled medium at its Antioch, Calif., mill in 1988.

However, capacity growth for corrugating medium is expected to be much slower over the 1989-92 period. Total medium capacity is expected to grow at a 2.2%/year rate, with semichemical growing at a 1.7%/year rate and recycled decelerating to 3.7%/year, according to the 1989 API capacity survey. Part of this reduction in growth rates is due to Green Bay Packaging Inc.'s plan to convert the medium machine at its Wisconsin mill at least partly to recycled linerboard beginning in fall 1990. The next API capacity survey (due in late 1990) may show semichemical medium capacity declined in 1990 because of the shutdown of the 100,000-tpy Clinch River mill at the end of 1989. A new owner has plans to eventually convert the mill to recycled medium production.

MAJOR U.S. CORRUGATING MEDIUM EXPANSION PROJECTS

Company	Mill location	Capacity (000 short tpy)	Startup date
Announced			
Mead	Stevenson, Ala.	35	1989
Cascades	Niagara, N.Y.	45R	1989
Corrugated Services	Forney, Texas	27	1989
Stone Container	Uncasville, Conn.	60R	1989
Temple-Inland	New Johnsonville, Tenn.	33	1989
Clinch River[1]	Harriman , Tenn.	(107)	1990
Visy Board[2]	Hartford City, Ind.	70R	1990
Temple-Inland	Newport, Ind.	42R	1990
Willamette	Hawesville, Ky.	30	1990
Green Bay Packaging[3]	Green Bay, Wis.	(150)	1991
Menasha	Otsego, Wis.	60	1991
Virginia Fibre	Riversville, Va.	165	1992
Weston	Terre Haute, Ind.	60	1992
Weyerhaeuser	Valliant, Okla.	55	1992
Proposed			
Jefferson Smurfit[4]	Fernandina Beach, Fla.	210	1991
Clinch River[1]	Harriman, Tenn.	88R	n.a.
Green Bay Packaging[3]	Green Bay, Wis.	150	n.a.

R = recycled medium.
n.a. = not available.

1. Clinch River closed at the end of 1989 due to financial difficulties; new company (Addington Environmental Services) may convert the mill to recycled medium.
2. New mill built with used equipment by Pratt Group of Australia.
3. Company plans to convert medium machine to recycled linerboard production in late 1990. The company may then install a new semichemical medium machine sometime in the future.
4. Company plans to reactivate idle machine producing recycled containerboard (including linerboard).

The corrugating medium market will probably begin to recover in 1991 because poor industry profitability is beginning to limit capacity growth. Total industry capacity is expected to increase only 0.5% in 1991. Some recycled medium mills, such as Stone Container's 130,000-tpy York, Pa., mill, may be shifted over to recycled bag paper production to fill growing demand for that grade.

CANADIAN CONTAINERBOARD MARKET

The Canadian containerboard industry (both linerboard and medium, including recycled) is much smaller than the U.S. industry. Canada has capacity to produce about 2.5 million short tpy, compared with about 30 million tpy for the U.S. This reflects the fact that the Canadian industry serves mainly the domestic market, which has a population of only 25 million and an economy about one-twelfth the size of the U.S. economy. About 90% of the industry's production is integrated forward to corrugated container production.

Canada's containerboard industry developed behind high tariff walls, and many of its facilities are not competitive in size or scale with mills in the U.S. The higher cost structure for the Canadian industry also reflects the fact that linerboard is a fiber-intensive grade, while the growing cycle for wood in northeastern Canada is slow, and harvesting and transportation costs are high. Until 1980, a 15% tariff protected the containerboard industry. Under GATT (General Agreement on Tariffs and Trade) negotiations completed in the late 1970s, tariffs dropped to 6.5% in 1987 for kraft linerboard and 4% for corrugating medium. Staged reductions during the next five years will eliminate the tariffs by 1993.

It is still uncertain how the new Free Trade Act between the U.S. and Canada will affect imports and exports of containerboard and corrugated containers. In 1988, the U.S. exported only 23,000 short tons of corrugated containers to Canada.

The move toward a more open, internationally competitive marketplace will be painful for many Canadian producers. Since 1977, three containerboard mills have closed—

CANADIAN CONTAINERBOARD PRODUCTION

(000 metric tons)

Year	Total containerboard	Linerboard*	Corrugating medium*
1989	1,939	1,214	725
1988	1,961	1,246	715
1987	1,954	1,255	699
1986	1,847	1,199	648
1985	1,677	1,126	551
1984	1,695	1,087	608
1983	1,575	1,021	554
1982	1,364	891	473
1981	1,646	1,088	558
1980	1,671	1,175	496
1979	1,544	1,078	466
1978	1,520	1,023	497
1977	1,434	1,037	397
1976	1,315	949	366
1975	1,031	726	305
1974	1,494	1,031	463
1973	1,413	975	438
1972	1,240	855	385
1971	1,033	686	347
1970	1,041	710	331

*Includes some recycled paperboard.
Source: Canadian Pulp & Paper Assn.

U.S. PRICES FOR CORRUGATING MEDIUM

(semichemical, 26-lb, eastern U.S.)

Year	$/short ton	$/1,000 ft²
1990		
4Q	$320*	$4.16
3Q	320/330*	4.16/4.29
2Q	330/340*	4.29/4.42
1Q	340/350*	4.42/4.55
1989		
4Q	350/360*	4.55/4.68
3Q	360/370*	4.68/4.81
2Q	380/390*	4.94/5.07
1Q	380/390*	4.94/5.07
1988		
4Q	390/400*	5.07/5.20
3Q	390/400*	5.07/5.20
2Q	400*	5.20
1Q	360/370*	4.68/4.81
1987		
4Q	350/360*	4.55/4.68
3Q	330/340*	4.29/4.42
2Q	320/330*	4.16/4.29
1Q	320/330*	4.16/4.29
1986		
4Q	290/300*	3.77/3.90
3Q	290/300*	3.77/3.90
2Q	250/260*	3.38/3.51
1Q	240*	3.12
Year end		
1985	240	3.12
1984	310	4.03
1983	280	3.64
1982	240*	3.12
1981	260*	3.38
1980	260	3.38
1979	240	3.12
1978	210	2.73
1977	180*	2.34
1976	200*	2.60
1975	190	2.47
1974	190	2.47
1973	140	1.82
1972	123	1.60
1971	120	1.56
1970	120	1.56

Prices shown above generally reflect net transaction levels in the eastern U.S. Medium prices tend to have a broader range than linerboard and vary regionally. Prices are typically lowest in the Northeast and may be somewhat higher in parts of the Midwest and South. Prices on the West Coast may be $10 to $20/ton higher than those in the eastern U.S.

Basis weight differentials: Based on eastern list for 26-lb semichemical medium of $350 ($4.55/1,000 ft²), prices for other weights are about as follows: 30 lb, $350 ($5.25); 33 lb, $350 ($5.78); 36 lb $350 ($6.30) and 40 lb $360 ($7.20). Prices for recycled medium are generally about $10/ton below those of semichemical medium.

*Indicates some discounting below transaction levels shown.
Source: *Pulp & Paper Week.*

two export-oriented kraft linerboard mills (Labrador Linerboard and MacMillan Bloedel) and a recycled linerboard mill. In total, these closures removed about 500,000 tpy of linerboard capacity from the market, although production still showed some growth. During the 1977-88 period, production of linerboard in Canada increased from 917,000 tons to nearly 1.4 million tons. At the same time, corrugating medium grew at a faster rate, rising from 341,000 tons to 781,000 tons, according to the Canadian Pulp & Paper Assn.

The Canadian linerboard industry is far more dependent on secondary fiber. Recycled linerboard accounts for about 25% of total linerboard capacity, compared with about 3% in the U.S. However, recycled medium in Canada accounts for about 19% of total production—slightly lower than in the U.S.

The corrugated container industry in Canada is almost totally integrated, with independents having well under 10% of the corrugated market (vs roughly 20% in the U.S.). Two integrated corrugated companies, Domtar Inc. and MacMillan-Bathurst Inc., account for more than half of the Canadian industry's box production. MacMillan Bathurst is a 50:50 joint venture of MacMillan Bloedel Ltd. and Stone-Consolidated Inc. Canadian Pacific Forest Products Ltd., formerly CIP Inc., ranks third with about an 11% share of the market. In 1988, Canadian corrugated box capacity totaled 31.5 billion ft^2.

More than 25% of both linerboard and medium production is shipped outside of Canada. (Eurocan Pulp & Paper Co. is the largest liner exporter, and Stone-Consolidated and Papier Cascades Inc. are the biggest medium exporters.) While imports of linerboard are relatively small, imports of finished boxes have grown significantly. During 1982, a large part of the eastern Canadian corrugated industry was shut down by labor problems, and several U.S. box plants located near the border started shipping into Canada.

Canadian containerboard prices tend to follow those in the larger U.S. market, although they are at somewhat higher levels even after duty. Canadian producers last raised list prices on Apr. 1, 1988. Kraft linerboard (42 lb) went up C$35/metric ton to $675 list, and semichemical medium (26 lb) rose $30/ton to $630. Reflecting the increase in raw material costs, Canadian corrugated box manufacturers raised prices by 5% to 6%. Containerboard and box prices, however, have been eroding for the past couple years.

Some industry experts doubt if another kraft linerboard mill will ever be built in Canada, although incremental expansion is taking place. The 1990 CPPA capacity survey showed kraft linerboard capacity increasing 20.7% to 1.1 million metric tons between 1989 and 1992. This mainly reflects Eurocan's rebuild of a machine at its Kitimat, B.C., mill, which will add 105,000 tpy of capacity. (Pulping will be expanded through installation of a chemi-mechanical pulping system—a new type of pulp for manufacturing kraft linerboard.) Recycled linerboard capacity will rise about 12.7% to 430,000 tons by 1990.

Semichemical medium capacity is expected to rise 6% to 704,000 tons by 1992. Stone-Consolidated installed a new 150,000-tpy machine at its Matane, N.B., mill in late 1988, replacing two older machines. Recycled medium capacity is expected to remain relatively stable at around 100,000 tpy in 1990.

ESTIMATED CONTAINERBOARD CAPACITY OF MAJOR CANADIAN PRODUCERS

(000 metric tpy)

	Linerboard	Corrugating medium	Total containerboard
Domtar	270**	145**	415
Stone-Consolidated	200	160[1]	360
CIP	225	85	310
Eurocan Pulp & Paper	268[2]	—	268
Paperboard Industries[3]	85*	50*	135
Cascades	—	115**	115
Atlantic Packaging	60*	40*	100
Irving (Lake Utopia)	—	90	90
Kruger	90*	—	90
MacMillan Bloedel	—	70	70
Crown Forest	35	25	60

*Recycled containerboard.

**Includes some recycled containerboard capacity.

1. New 150,000-tpy machine installed at Bathurst, N.B., mill replaced two older machines for 45,000-tpy net increase in 1989.
2. Rebuild increased Kitimat, B.C., mill's capacity 105,000 tpy in 1989.
3. Includes Belkin Packaging acquired in 1987.

Paperboard:

COATED AND UNCOATED KRAFT

Unbleached kraft paperboard other than linerboard is produced for three major packaging markets: beverage carriers, folding cartons, and multi-pack packaging for products traditionally packaged in corrugated containers. The remainder is used for tube, can, and drum stock and other industrial converting applications. These miscellaneous uses are discussed at greater length in the chapter on converted products.

Unbleached kraft board is produced from 100% unbleached kraft sulfate pulp. A small amount of wastepaper may also be used in the kraft pulp furnish.

Coated and uncoated kraft boxboard is unique because it offers a package with much higher strength than equivalent-weight bleached and recycled boxboard grades. In many cases, the strength of kraft boxboard allows dual-packaging capabilities as both a shipping container and a folding carton that can be displayed. In addition, coated kraft boxboard is well suited for high-quality printing and foil and film laminating. Because of these properties, kraft board has had a major impact in the folding carton market.

Kraft boxboard and converting grades comprise only 7% of the total unbleached kraft paperboard market, but they account for approximately 18% of the domestic boxboard market (about 1 million short tons). The boxboard grades are also known as clay-coated linerboard, coated unbleached kraft, the trademark solid unbleached sulfate (SUS), and coated natural kraft (CNK).

The principal market for kraft boxboard is beverage-carrier stock—mainly for six-packs of bottled beer, soft drinks, wine coolers, and mineral water, and also for larger 24-packs of beer in cans. The carrier market consumes nearly 70% of total kraft boxboard tonnage. Carrier stock used in refrigerated applications is made with wet-strength additives in either the kraft furnish, the coating, or both. Typically, carrier stock has a basis weight of about 84 lb/1,000 ft^2 and a caliper thickness of 20 pt.

More recently, such clay-coated board has made a significant breakthrough in traditional folding carton markets. Kraft boxboard competes with recycled clay-coated newsback (CCN) and solid bleached sulfate (SBS) board. Kraft boxboard provides better stiffness, tear resistance, and moisture resistance than SBS, and it has better printing and strength qualities than CCN. Kraft boxboard is often used in larger-size packages for detergents and other nonfood items and as institutional packaging for wholesale distribution.

UNBLEACHED KRAFT PAPERBOARD CAPACITY FOR FOLDING CARTONS AND OTHER USES

(000 short tons)

Year	Folding cartons[1]	Other uses[2]
1992e	1,448	521
1991e	1,344	521
1990e	1,180	521
1989e	1,151	521
1988	1,055	509
1987	1,000	473
1986	946	501
1985	905	500
1984	792	477
1983	800	493
1982	860	509
1981	804	540
1980	852	529
1979	827	520
1978	650	540
1977	645	561
1976	595	525

e = Estimate.

[1] Includes carrier board.

[2] Includes tube, can, and drum stock.

Source: American Paper Institute.

Kraft boxboard is also used as preprinted linerboard for small corrugated containers that are used to package consumer products. Such boxes are used not only to ship the product but also to serve as point-of-purchase displays.

INDUSTRY STRUCTURE

Manville Forest Products Corp. and Mead Corp. together produce nearly all of the U.S. supply of coated and uncoated kraft board. Manville has production capacity of about 600,000 tpy of coated SUS kraft board on three machines at West Monroe, La. Two of the machines underwent major rebuilds in the last few years to improve the multi-ply forming sections. The rebuilds were designed to improve product quality and machine productivity of coated kraft board. Manville markets its products as PearlKote folding carton board and AquaKote beverage carrierboard.

Mead's 1989 capacity for grades it refers to as CNK is approximately 430,000 tpy at the company's Mahrt, Ala., mill. The startup of a new 370,000-tpy coated kraft paperboard machine at Mahrt in fourth-quarter 1990 will raise the mill's capacity to 800,000 tpy. Some of this new capacity will initially be used to produce kraft linerboard during the first full year of operation in 1991. Mead's coated kraft products include Carton Kote, Carrier Kote, and Carrier Kote II.

Mead acquired 100% ownership of the former Georgia Kraft Co. mill in early 1988, when it dissolved its joint venture with Temple-Inland Inc. Soon after this transaction, Mead broke ground for the $560-million expansion to install the new coated board machine as well as new pulping and other process equipment

Westvaco Corp. is the third player in this market, although its Kraftpak unbleached folding carton board is an uncoated grade. Westvaco has an estimated 70,000 tpy of low-density Kraftpak board capacity at its North Charleston, S.C., kraft mill. Westvaco is a major supplier of uncoated laminating stock to packaging customers. Westvaco's uncoated board is also approved by the Food & Drug Administration for food packaging, so its food-grade boards are used for packaging a variety of dry and frozen foods and for bulk packaging in fast-food and institutional markets.

In 1989, Manville, Mead, and Westvaco together had an estimated total unbleached kraft boxboard capacity of 1.2 million tons. Industry capacity is forecast to increase to about about 1.5 million tons by 1992.

In Europe, coated kraft boxboard competes with similar grades produced in Sweden and Finland. Major European producers are the Billerud AB and Papyrus Kopparfors AB divisions of Stora, ASSI (AB Statens Skogsindustrier), and Korsns-Marma AB.

MARKET STRUCTURE

Demand for coated kraft board is driven by the rise in packaging demand by the food and beverage industry. This demand accounted for 45% to 50% of the value and over 50% of the volume tonnage of folding cartons (including beverage carriers) that were shipped in 1989.

About 56% of the folding carton industry's 1989 consumption of boxboard was supplied by bleached and unbleached kraft grades, up from 53% in 1985. SBS is the most widely used kraft grade with about 37% of the market. Unbleached kraft accounts for 18.4% of the market.

Consumption growth of SBS has been supply-constrained in the past two years, so the unbleached kraft grades have accounted for most of the growth in the kraft grades. Demand for unbleached kraft grew at the rate of 8.8%/year during the 1960s and 4.6%/year during the 1970s—a higher growth rate than the overall boxboard market, and outperforming both SBS and clay-coated recycled grades.

The use of clay-coated unbleached kraft board in folding cartons and carriers grew primarily because it offers considerable savings over SBS and because it is stronger than recycled board. Other industry statistics indicate that SBS usage in boxboard production increased an average of 4.1%/year during 1983-88. Unbleached kraft boxboard usage increased about 7.5%/year during the same period. Recycled boxboard usage increased an average of 3.0%/year.

In recent years, the folding carton market has been most promising for coated unbleached kraft board producers; future growth is limited only by available capacity. Demand for beverage carriers wavered in the early 1980s as beer consumption eased and as more beverages were bottled in two-liter plastic containers. But this market is rebounding, boosted by a heightened interest in better packaging graphics and by growth in new products such as wine coolers.

Bruce Kirk of Goldman Sachs & Co. estimated that clay-coated kraft board for folding cartons and similar retail

U.S. PRICES FOR COATED KRAFT BOARD

($/short ton)

Year	20-pt, folding carton, C1S 80 bright (rolls)	20-pt beverage carrier, C1S 80 bright (rolls)
1990		
2Q	$615-620	$625
1Q	615-620	625
1989		
4Q	615-620	625
3Q	615-620	625
2Q	575-580	625
1Q	575-580	625
1988		
4Q	535-540	580
3Q	535-540	580
2Q	505-510	560
1Q	505-510	545
1987	505-510	540-545
1986	460-485	500-525

Source: *Pulp & Paper Week.*

merchandise packaging has grown consistently in recent years, with minimal cyclicity. Industry production increased 100% between 1975 and 1988, when it reached about 925,000.

Clay-coated unbleached kraft board, in terms of price and quality, is positioned between clay-coated recycled board and SBS used in milk cartons, cup/plate/food service items, and folding cartons. Generally, coated unbleached kraft board is priced about $100/ton higher than the recycled equivalent and $200/ton lower than the SBS equivalent. In 1989, the prevailing price of 20-pt clay-coated kraft folding carton board was about $580/ton, rising to about $620/ton at the end of the year. The price of beverage carrierboard grades was about $625/ton, rising to $650/ton in the third quarter of 1990.

Compared with SBS, coated kraft has higher values for tear, mullen or puncture, machine-direction stiffness, and machine-direction block compression. This means a lower-caliper coated kraft board can substitute for SBS, resulting in a 3% to 4% material savings, which is in addition to the 12% to 15% cost savings. According to Manville, it all adds up to a 15% to 19% savings over SBS.

. Unbleached kraft board is cheaper to produce because the manufacturing process requires fewer chemicals and less energy and labor. In addition, unbleached kraft has greater strength because it is not bleached, a process that weakens fibers.

Manville Forest Products Corp. Manville makes its SUS grades at its West Monroe, La., mill on Nos. 2, 6, and 7 paper machines. In recent years, major upgrades have improved quality and increased capacity at the mill, and the company is considering the rebuild of an idle No. 4 machine at the mill or the installation of a new machine with capacity in the range of 800 to 1,000 tpd.

In mid-1985, Manville completed a rebuild of No. 7 paper machine, which makes PearlKote—its third generation of solid unbleached sulfate. This project reduced board plies to three from four, and it raised capacity to 575 tpd from 540 tpd. Machine capacity is expected to increase to about 800 tpd by 1990.

Arcu-Formas on the machine were removed and replaced with a third fourdrinier. No. 7 has a maximum speed of 1,500 fpm with a normal trim of 232 in. It has the largest yankee dryer in the world and coats the board in three stages, which gives it the bright blue finish.

No. 7's output is converted to food cartons (for frozen pizzas, ice cream, candy, etc.) and boxes for various consumer products and hardware items (e.g., diapers and automobile shock absorbers). It is coated one side (the printing side) and brown (unbleached) on the inside. Calipers range from 14 to 32 pt, and basis weights vary between 56 and 116 lb/1,000 ft^2. Some of the board is polyethylene-extruded on one or both sides by converters for wet or frozen end-use applications. It is marketed throughout the U.S.

No. 2 machine produces 235 tpd of lightweight (16-to-20-pt caliper) clay-coated board for both the beverage carrier and the folding carton markets, as well as a clay-coated preprinted linerboard. No. 2 machine, which dates from the 1930s, is expected to be retired in the mid-1990s.

No. 6 machine produces mainly AquaKote wet-strength beverage carrier board. It was rebuilt in 1987 and is slowly reaching its annual rated capacity of 900 tpd. The other two machines, Nos. 1 and 5, make semichemical corrugating medium and lightweight kraft paper, respectively, for grocery bags and sacks.

Mead Corp. Mead, too, is moving ahead with improvements and expansions. Before the startup of its new machine, Mead made all of its CNK grades on a 262-in.-wide fourdrinier at the Mahrt mill. The new Valmet coated board machine has design capacity of 1,000 tpd with a 300-in. wire width and a design speed of 2,560 fpm. Mead's 1989 production capacity was 430,000 tons, or 39% of industry output. It converts 260,000 tpy, or about 60% of output, at its own domestic beverage carrier and folding carton facilities. The balance of output—170,000 tons, or 40%—is sold on the domestic market to other converters or to Mead's offshore affiliate producers. Mead expects to export about 50% of the production from its new machine.

Mead's paperboard packaging business underwent significant consolidation and restructuring in 1987. It shed its linerboard and recycled paperboard operations as well as six of its fourteen corrugated box plants, but it retained the Stevenson, Ala., corrugating medium mill. These divestitures were designed to focus corporate assets on value-added specialty products with higher and less-cyclical profit margins, with major emphasis on CNK.

UNBLEACHED KRAFT PAPERBOARD PRODUCTION BY GRADE, 1968-89

(000 short tons)

	Domestic					
Year	Containerboard[1]	Boxboard[2]	Tube/can	Other	Exports	Total
1989	15,833	987	150	157	2,363	19,490
1988	15,601	924	155	165	2,296	19,140
1987	15,380	865	161	190	2,303	18,898
1986	14,174	889	164	217	2,237	17,680
1985	13,353	822	164	198	1,830	16,367
1984	13,950	752	192	205	2,086	17,185
1983	12,720	710	204	207	2,281	16,122
1982	11,563	691	193	157	1,931	14,535
1981	12,654	672	219	171	1,887	15,603
1980	11,852	680	226	157	2,380	15,295
1979	12,306	698	267	234	1,645	15,150
1978	11,780	618	251	258	1,466	14,373
1977	11,283	588	228	262	1,290	13,651
1976	11,024	577	217	266	1,247	13,331
1975	9,586	463	176	260	1,058	11,543
1974	10,754	470	231	295	1,583	13,333
1973	10,951	455	226	333	1,597	13,562
1972	10,470	389	223	298	1,887	13,269
1971	9,155	339	194	276	1,834	11,800
1970	9,043	343	175	295	1,683	11,541
1969	9,242	287	187	417	1,683	11,816
1968	8,535	261	175	409	1,381	10,761

1. Containerboard figure is mostly linerboard from 1968-78, and is entirely linerboard after 1978.
2. Boxboard figure is folding carton stock and carrier board.
Source: American Paper Institute.

Paperboard:

BLEACHED

Solid bleached sulfate (SBS) paperboard is used primarily for folding carton and milk carton packaging, and it is produced from a furnish containing at least 80% virgin bleached woodpulp. SBS is also used in the manufacture of disposable cups, plates, and food containers, as well as in bleached linerboard. It is sometimes substituted for bleached printing bristols, which are also produced by some SBS mills. (See chapter on bristols.)

Bleached board is produced in calipers ranging from 10 to 28 pt and in basis weights ranging from 40 to 100 lb/1,000 ft². Sheet density is the basis weight divided by the caliper. Density starts at about 10.5 lb/pt (lb/pt of caliper on 1,000-ft² basis) or less for low-density board, and it goes up to 16.0 lb/pt or more for high-density board. Medium-density board is in the range of 12.0 to 14.0 lb/pt.

U.S. STATISTICS FOR BLEACHED BOARD

	1990e	1989	1988	1987
Production[1], 000 tons	4,594	4,521	4,511	4,406
Capacity, 000 tons	4,838	4,723	4,733	4,679
Utilization rate, %	95.0	95.7	95.3	94.2
Exports, 000 tons	761	683	628	619
Imports, 000 tons	40	20	10	7
Apparent U.S. consumption				
000 tons	3,883	3,858	3,893	3,794
lb/capita	31.6	31.1	31.7	31.2
000 tons/billion $ real GNP (1982)	0.92	0.93	0.97	0.99

e = Estimate.
1. All tons are short tons.
Sources: American Paper Institute, *Pulp & Paper* estimates.

Additives are often mixed with SBS stock furnish to give the sheet certain characteristics, and coatings are added to smooth and seal the sheet. In folding carton board, for example, the sheet is typically coated with a 4-lb/1,000-ft² coat weight—typically a kaolin clay coating using S-B latex as binder. Acrylic binders are also commonly used. In liquid packaging furnish, synthetic waxes and polyethylene (PE) resin coatings are added to improve sheet holdout (liquid resistance) properties.

Nearly all bleached board that is used in folding carton stock is clay coated, and nearly all board that is used in frozen and liquid food packaging is coated with PE resins. Coating formulas vary according to the desired surface requirements and degree of holdout. On-machine blade coaters are typically used with most machines, but milk carton stock is usually extrusion-coated off the machine at the paper mill.

Gloss calenders are used with machines to improve the finish of high-gloss board. These high-gloss finishes are called cast coatings—a reference to the process in which coated board is pressed against a finished casting surface while the coating is still in a highly plastic state.

A blend of softwoods and hardwoods in about equal proportions is used to make SBS board. The mix is varied according to desired strength, density, and printability. Softwood content is higher for liquid packaging, for example, because of superior tear and tensile strength properties.

Bleached board is generally made on a conventional fourdrinier paper machine, a flat-forming suction type, with a secondary headbox commonly included to improve sheet formation and smoothness. Limited use is made of multi-fourdrinier paper machines in North America, but several liquid packaging producers have recently converted their machines to produce a multi-ply board.

A multi-fourdrinier machine combines a series of separate fourdrinier sections and headboxes on a single machine to produce a multi-ply board that has superior stiffness and less weight than a single-ply board. Also, a multi-ply board may contain mechanical pulp in the middle ply. For example, the top and bottom layers are made from hardwood and softwood bleached kraft (or sulfite) pulp, and the middle ply is made from chemi-thermomechanical pulp (CTMP) or thermomechanical pulp (TMP). The cost is generally lower due to the use of lower-cost groundwood pulp.

Multi-fourdrinier machines have been successfully operated for several years in Europe, but they have only recently been accepted in North America. Continental Forest Industries Inc. installed a new multi-ply machine at its Augusta, Ga., mill in 1978, but the mill experienced severe operating problems with the Voith equipment. The mill was subsequently sold in 1985 to Federal Paper Board Co. In late 1990, Federal will complete a project to convert the mill's No. 3 machine to produce 100% single-ply bleached kraft SBS paperboard with approximately 400 tpd of additional capacity.

In 1988, Cascades Inc. converted an older cylinder board machine at its Jonquière, Que., mill to a three-fourdrinier machine using Ahlstrom/Valmet technology. The Cascades machine uses TMP and bleached kraft pulp to produce a double-white, three-ply board that could replace SBS in packaging applications.

In 1990, Tembec Inc. started up a new Tampella three-fourdrinier machine at its Temiscaming, Que., mill. Tembec's new machine will produce 140,000 metric tpy of low-density, coated three-ply bleached paperboard using a combination of CTMP and sulfite pulp. In the U.S., Weyerhaeuser Co., Potlatch Corp., and International Paper Co. have upgraded their existing liquid packaging board machines by installing new twin-wire systems and dual-channel headboxes to produce a low-density multi-ply board with improved sheet formation, smoothness, stiffness, and printing characteristics.

INDUSTRY STRUCTURE

Bleached paperboard is manufactured by 13 major suppliers in the U.S. and by three in Canada. U.S. capacity is fairly concentrated, with the top five producers accounting for over 65% of industry capacity. International Paper, Federal Paper Board, and Westvaco Corp. are the three largest producers. Most SBS producers have recently increased or plan to increase capacity mostly through productivity improvements or incremental machine upgrades.

The only new SBS machine scheduled to be built in the U.S. is a $400-million capital project announced by Westvaco for the company's Covington, Ky., mill. The new machine represents the largest SBS expansion since Westvaco installed a new 175,000-tpy machine also at Covington in 1986. The new SBS machine is expected to initially produce 600 tpd at startup in mid-1992 but will have the capabilty to expand to about 1,000 tpd.

Gulf States Paper Corp. plans to double the bleached

U.S. BLEACHED BOARD PRODUCTION BY END USES[1]

(000 short tons)

Year	Total	Cartons Folding	Cartons Milk	Heavyweight cup stock	Plate, dish, and tray	Linerboard	Other food packaging	Miscellaneous packaging[2]
1989	4,906	2,212	1,143	426	323	445	284	73
1988	4,973	2,245	1,092	500	274	523	280	59
1987	4,636	2,023	1,116	486	270	404	281	55
1986	4,535	2,076	1,226	442	276	121	348	45
1985	4,282	1,955	1,227	422	245	(D)	404	29
1984	4,104	1,895	1,092	455	225	118	288	31
1983	3,988	1,901	1,060	440	252	113	191	31
1982	3,757	1,743	1,052	418	227	101	184	32
1981	4,070	1,981	1,085	427	245	120	223	49
1980	4,026	2,063	1,015	401	263	—	—	40
1979	3,883	1,999	1,090	341	232	102e	—	119
1978	4,002	1,934	1,048	400	277	159e	—	184
1977	3,882	1,822	1,040	419	296	92	53	160
1976	3,876	1,880	1,050	370	267	103	23	183
1975	3,420	1,540	1,052	329	274	88	—	[illegible]
1974	3,827	1,706	1,055	442	322	104	—	[illegible]
1972	3,741	1,637	1,006	389	350	139	—	220
1970	3,404	1,395	971	369	317	133	—	219

(D) = Data withheld to prevent disclosure of figures for individual companies.
e = Estimate.
1. Production for both foreign and domestic uses.
2. Includes other food packaging when not included in separate category 1970-79.
Source: Bureau of the Census.

pulping capacity of its Demopolis, Ala., mill in anticipation of adding a new SBS machine in the mid-1990s. The pulp mill expansion will give Gulf States the capability of doubling its current capacity of 750 tpd of bleached kraft pulp. The company will increase its output of market pulp until a final decision is made concerning the addition of a new SBS machine.

As previously mentioned, Federal significantly expanded its market share in 1985 with the acquisition of Continental Forest's Augusta, Ga., mill. Jefferson Smurfit Corp. entered the bleached board segment in 1986 when it acquired ownership of Container Corp. of America's Brewton, Ala., mill. Georgia-Pacific Corp. doubled its SBS production capacity in 1988 when it purchased Brunswick Pulp & Paper Co. in Brunswick, Ga., a former joint venture of Mead Corp. and Scott Paper Co.

Swing capacity. Some companies that produce bleached paperboard packaging grades also produce lightweight bleached printing bristols and bleached kraft pulp on the same paper machines. This allows producers to adjust or "swing" production between grades in response to market conditions and perhaps take advantage of more profitable markets. However, many mills prefer to remain consistent with their grade mix unless markets change substantially. Also, very little swing capacity is available when SBS board supply is tight.

In the early 1980s, as much as 200,000 to 300,000 tons of bleached pulp was annually produced on bleached board machines. Most of this pulp was not papermaking chemical-grade bleached pulp; rather, it was highly absorbent fluff pulp used in the manufacture of disposable diapers and other sanitary products. This fluff pulp was shipped in rolls rather than baled.

Requirements for fluff pulp have become more specialized, and overall growth in demand has slowed due to the introduction of superabsorbents. Furthermore, two leading producers of fluff pulp that also produce bleached board—Weyerhaeuser and International Paper—have shifted production from swing machines to dedicated facilities.

American Paper Institute data show that pulp produced on SBS machines steadily declined from 97,600 tons in 1984 to 54,000 tons in 1985, 27,915 tons in 1986, 41,473 tons in 1987, 15,005 tons in 1988, and 8,200 tons in 1989. Rising demand for SBS board and surplus capacity of market pulp hastened the shifting emphasis to SBS.

In addition to reducing swing capacity, producers have also lowered the basis weight and density of SBS boards. A lower-density board with stiffness and quality comparable to higher-density board of several years ago is now possible. The result is more units of product per ton of board. Upgrading the printing quality of folding carton board is another trend in the U.S. market. Examples are Westvaco's premium-grade Printkote Hi-Gloss stock and IP's Val-U-Coat board.

From 1970 to 1979, bleached board capacity grew at a 1.7% annual rate, but it declined 1.9% during 1979-84, ac-

U.S. BLEACHED BOARD PRODUCTION

Year end	Tonnage (000 short tons)	Change (%)
1989	4,521	0.2%
1988	4,511	7.2
1987	4,406	4.7
1986	4,207	7.6
1985	3,911	-2.5
1984	4,011	3.0
1983	3,895	6.9
1982	3,644	-6.2
1981	3,886	1.3
1980	3,836	-3.4
1979	3,973	0.5
1978	3,955	6.8
1977	3,703	-3.1
1976	3,820	14.9
1975	3,324	-11.4
1974	3,752	-2.3
1973	3,842	4.8
1972	3,667	9.0
1971	3,363	1.1
1970	3,327	-6.5
1969	3,560	—

Source: American Paper Institute.

CAPACITY FOR BLEACHED BOARDS OF MAJOR U.S. COMPANIES

Company	Annual capacity (000 tons)*	Capacity share (%)
1. International Paper[1]	935	19.7
2. Federal Paper Board[2]	631	13.3
3. Westvaco	620	13.1
4. Potlatch	554	11.7
5. Georgia-Pacific[3]	360	7.6
6. Temple-Inland	357	7.5
7. Champion international	247	5.2
8. James River	235	4.9
9. Gulf States Paper	230	4.8
10. Weyerhaeuser	220	4.6
11. Gilman Paper	200	4.2
12. Jefferson Smurfit	185	3.9
13. Union Camp[4]	140	n.a.

Capacity share of top five companies: 65.4%
Capacity share of top ten companies: 92.4%
Total U.S. capacity (1990):
4.838 million short tons
Estimated available 1990 capacity:
4.728 million short tons

n.a. = Not available.
1. Will lose 50,000 tons in 1990 from downtime.
2. Will lose 60,000 tons in 1990 from downtime.
3. Acquired Brunswick Pulp & Paper Co. in 1988.
4. Includes more than 50% swing capacity.

cording to API figures. In 1985, however, capacity began to creep up again, rising from 4.37 million short tons to 4.84 million tons in 1990. Capacity is expected to grow at about a 3.3% annual rate between 1990 and 1992, reaching 5.20 million tons in 1992.

The primary cause for the jump in capacity between 1985 and 1986 was the startup of a new 175,000-tpy SBS machine at Westvaco's Covington, Va., mill. However, some of this capacity was offset by the shutdown of a smaller, older machine at the same facility. API initially projected more substantial capacity gains in the late 1980s, but several companies stretched out expansion plans for their mills.

The majority of the 27 bleached paperboard machines in the U.S. are located in the Southeast. Most range in capacity size from 150,000 to 250,000 annual tons, and more than half were installed or rebuilt after 1970. Companies have also improved the efficiency of their mills in recent years through new labor rules and capital spending projects. Several producers such as Federal Paper Board, Potlatch, International Paper, and Temple-Inland Inc. have also undertaken major energy conservation projects at their mills.

From 1976 to 1985, bleached board production rose at about a 1.5% annual rate. The weak performance was due to lower domestic demand for milk cartons in favor of plastic containers, competition from plastics in the food-service segment, and slower export growth. Another factor that held back SBS tonnage growth was a trend toward reduced basis weights, especially for folding cartons.

Since 1986, demand for SBS has been very good. Total U.S. production of bleached board in 1986 was up 8.7% to 4.29 million tons after a drop of 2.5% to 3.95 million tons in 1985. In 1987, production again rose, moving up 3.2% to 4.4 million tons, and in 1988 it reached a record 4.51 million tons. Operating rates rose to 94.5% in 1987 and 95.3% in 1988. In 1989, production increased by only 0.5% to 4.52 million tons because all available production capacity was utilized and the industry was capacity-constrained.

During the past decade, U.S. bleached board exports grew at about a 6% to 7% annual rate and accounted for approximately 12% to 14% of total U.S. production. From a peak of 557,000 tons in 1981, however, SBS production for export declined steadily to a low of 466,000 tons in 1985. The decline reflected the impact of the strong dollar and increased competition in Europe from Scandinavian producers. But as the dollar weakened, exports leaped 22% to 569,000 tons in 1986, and they increased further to 619,000 tons in 1987. In 1988, exports increased to 628,000 tons, and jumped to 693,000 tons in 1989. Milk carton stock accounts for about 75% of SBS exports, with the remaining 25% mostly folding carton stock.

Strong price trend. The price of SBS, which fluctuates with market conditions, has strengthened each year since 1986. Prices deteriorated between 1981 and 1985, except for a brief recovery in 1984 when some producers got as much as $645 to $665/short ton for 15-pt clay-coated folding carton stock. In 1981, the list price was a firm $625, which was eroded by discounting in 1985 to between $500 and $590, severely squeezing profitability.

Prices strengthened when market demand recovered in 1986. Producers raised prices an average of two times per year during the 1986-89 period. End-of-year prices for 15-pt clay-coated folding carton stock were approximately $580/ton in 1986, $635/ton in 1987, $730/ton in 1988, and $830/ton in 1989.

U.S. CAPACITY FOR BLEACHED BOARDS

(000 short tons)

Year	Linerboard	Folding	Milk carton and food service	Other	Total	Change (%)
1992e	197	2,634	2,132	240	5,202	2.9%
1991e	197	2,506	2,108	240	5,051	4.4
1990e	195	2,380	2,023	240	4,838	2.4
1989e	185	2,293	2,006	239	4,723	0.0
1988	170	2,323	2,017	222	4,733	1.2
1987	148	2,309	2,031	191	4,679	2.3
1986	135	2,341	1,926	175	4,576	4.7
1985	131	2,223	1,843	173	4,370	4.4
1984	119	2,095	1,771	200	4,185	2.1
1983	104	2,020	1,758	217	4,100	-3.0
1982	104	1,988	1,812	219	4,123	2.7
1981	108	1,904	1,774	229	4,015	-4.0
1980	116	1,954	1,865	246	4,180	-3.2
1979	133	2,080	1,916	189	4,318	2.9
1978	122	1,996	1,899	179	4,197	4.4
1977	97	1,930	1,824	170	4,020	0.6
1976	101	1,915	1,854	128	3,998	5.0
1975	95	1,751	1,859	102	3,807	-2.9
1974	108	1,851	1,848	113	3,920	-0.2
1973	141	1,749	1,899	139	3,928	3.7
1972	134	1,583	1,937	134	3,788	6.1
1971	143	1,455	1,842	128	3,569	2.8
1970	130	1,406	1,739	197	3,472	-2.4
1969	150	1,500	1,689	218	3,557	—

e = Estimate.

Sources: American Paper Institute, *Pulp & Paper* estimates.

MARKETS

Folding cartons are the largest end use for SBS board, accounting for approximately 49% of machine production capacity in 1989. Milk carton stock made up about 24% of the market; cup and plate, 18%; and linerboard and other packaging and nonpackaging stock (including printing boards, aseptic packaging, and ovenable paperboard), 9%.

The U.S. folding carton market is mature, but demand has grown about 3% annually since 1986, and SBS has maintained about a 38% share of the domestic market. API statistics for 1988 show total domestic folding boxboard production at 5.29 million tons, of which 2.35 million tons was recycled boxboard (44.4%), 2.02 million tons was SBS (38.2%), and 924,000 tons was unbleached kraft boxboard (17.4%). In 1989, the total domestic market was 5.37 million tons, with recycled (44.7%), SBS (36.9%), and unbleached kraft (18.4%).

The fastest growth in the folding carton market has been achieved by clay-coated unbleached kraft grades, which have nearly doubled their market share since 1972. Coated unbleached kraft grades offer greater strength than recycled boxboard and cost less than SBS, and they will probably continue to increase their share of the market. (See chapter on Coated and Uncoated Kraft board.) Prices for coated unbleached kraft folding carton grades are between those for SBS and recycled grades, averaging $540 to $580/ton in 1989.

U.S. BLEACHED BOARD EXPORTS[1]

(short tons)

Year	API[2]	Census
1989	683,000	784,846
1988	628,000	743,000
1987	619,000	648,000
1986	569,000	571,000
1985	466,000	518,000
1984	478,000	543,000
1983	514,000	558,000
1982	525,000	526,000
1981	557,000	584,000
1980	545,000	560,000
1979	466,000	490,000
1978	430,000	440,723
1977	389,000	374,823
1976	306,000	352,638
1975	—	284,203
1974	—	374,642
1973	—	265,169
1972	—	208,516
1971	—	183,257
1970	—	129,139
1969	—	131,946

1. Imports are minor.
2. American Paper Institute data represent production for export, not shipments.

In addition to the growing popularity of coated kraft grades, another competitive factor for SBS is the widening price gap with clay-coated recycled boxboard. The price differential between SBS and clay-coated recycled newsback (CCN) folding carton board reached an unprecedented level of $300/ton in 1989. Prices for CCN reached $480/ton in 1989, vs $780/ton for SBS. The differential increased to $315/ton in early 1990, when CCN prices reached $515/ton and SBS prices reached $830/ton. In the early 1980s, the price differential averaged between $150 and $200/ton. However, because of higher yield on an area basis due to lower density in bleached board, the extreme price differential between the two grades is somewhat reduced in the converting process.

SBS producers convert about 50% of their folding carton board output in their own manufacturing plants. The largest integrated SBS folding carton producers are International Paper, James River Corp., and Westvaco. The largest suppliers of SBS to independent folding carton converters are Federal Paper Board, Temple-Eastex Inc., Potlatch, Georgia-Pacific and Gilman Paper Co.

Folding carton profits have been poor for several years because prices for converted folding cartons have not kept pace with the rapid rise in SBS board prices. As a result, Champion International Corp., Temple-Eastex, and Potlatch have all divested their folding carton plants in recent years, while IP and Federal have closed money-losing folding carton plants.

Liquid packaging board. U.S. demand for liquid packaging board has fluctuated during the past two decades. Production rose in the early 1970s but declined over the next 15 years. Domestic milk carton production fell almost steadily from 941,000 short tons in 1970 to 591,000 tons in 1982. In 1983, however, production was up 2.7% to 607,000 tons, and it rose 6.3% in 1984 to 645,000 tons. In 1985 and 1986, production fell to 609,000 tons and 591,000 tons, respectively. In 1987, production rebounded again to 624,000 tons and then slipped to 606,000 tons in 1988. In 1989, production for domestic U.S. fell to 588,000 tons.

In 1985-86, liquid packaging board accounted for about 15% of sales within the sanitary food container industry, compared with 20% in 1972. Most of paperboard's loss of market share in milk packaging has been in the gallon and half-gallon sizes, mostly in the Midwest and West. Since 1980, erosion in the gallon segment has eased, but further loss in the half-gallon segment is still a concern. Some forecasts expect plastic to capture as much as 50% of the market currently held by paperboard in the half-gallon segment.

According to the Dept. of Agriculture, paperboard's total share of fluid milk packaging shifted from 78% in 1971 to 33% in 1987, the last year that this data is available. During that time, the market share of plastic containers (mostly high-density PE) went from 15% to 67%. Of the gallon containers sold for fluid milk packaging in 1987, 98.6% were plastic, and 1.4% were paperboard. In the half-gallon sizes, 23.5% were plastic, and 71.3% were paperboard. In the smaller sizes, paperboard still had approximately 97% to 99% of the market.

Besides competition from plastics, carton use is depressed because of modest growth in domestic milk consumption. In 1987, 54.416 billion lb of milk were consumed in the U.S. Although consumption was up 0.6% from the previous year, this figure is only a 1.3% improvement over 1976. From 1972 to 1982, domestic milk consumption steadily declined, but it has since turned around largely because of a small baby boom among young families.

Although carton use for milk packaging has declined, other types of liquid packaging are growing. This is especially true for juice and juice derivatives, and even wine. The Paperboard Packaging Council (PPC) estimated that juice and juice-drink cartons comprised 25% of the market in 1988, compared with about 5% ten years earlier. Paperboard cartons are also being used to package dry foods, pet foods, and various nonfood items, according to the U.S. Bureau of Industrial Economics.

For its part, PPC has fought further deterioration in the paperboard carton market with a campaign started in 1982 to publicize the nutritional advantages of milk packaged in paperboard instead of plastic. The promotion appears to be working. In 1983-84, domestic milk carton consumption was up for the first time since 1975. It slipped again in 1985 to the same level as in 1983, but this was attributed by some industry experts to a temporary halt in the PPC campaign when it was challenged by the plastics industry. The promotion was resumed in 1986 and ran through 1988.

Other promotions begun in recent years also could have increased milk carton sales. The paperboard gallon two-pack was introduced as an alternative to the plastic gallon jug. Another promotion, begun in 1985, features photographs and descriptions of missing children on side panels of milk cartons, an idea later extended to paper cups. However, this campaign was losing popularity by early 1987.

The most recent development has been the development of multi-ply barrier cartons that extend the shelf life and freshness of milk and other beverages. IP, Westvaco, and Potlatch have all developed their own versions of these high-tech cartons. These same companies have also developed cartons that feature a reclosable plastic pour spout to improve consumer convenience.

For all practical purposes, the domestic milk carton sector is 100% integrated from the manufacture of paperboard to the manufacture of cartons. IP and Champion International are the largest producers of milk carton blanks, which are shipped flat to dairies. The other integrated producers are Potlatch and Westvaco. The fifth U.S. producer of milk carton stock is Weyerhaeuser, which sold its Vancouver, Wash., milk carton plant to a subsidiary of AB Tetra Pak in mid-1989. In late 1989, IP expanded its integrated manufacturing operations in Canada when it purchased the Pure Pak packaging operations of Somerville Packaging.

Export demand for milk carton packaging has shown strong growth, averaging about 5% annually in recent years. In 1989, an estimated 510,000 tons—or 46%—of total milk carton production was exported. IP, Potlatch, and Weyerhaeuser are the major U.S. exporters of milk carton stock. The two other major U.S. producers, Champion International and Westvaco, do not export any significant amount of milk carton stock. U.S. producers are highly competitive with Swedish and Finnish producers in worldwide liquid packaging markets, and these two producing regions dominate the worlwide supply of paperboard liquid packaging.

Aseptic liquid packaging. This innovative multi-ply packaging system has expanded rapidly in the U.S. since its

U.S. PRICES FOR BLEACHED KRAFT BOARD

($/short ton)

Year	15-pt, folding carton, C1S 80 bright (rolls)	Heavyweigt cup stock, uncoated
1990		
2Q	$830/840*	n.a.
1Q	830/840	n.a.
1989		
4Q	830/840	$750/800
3Q	830/840	n.a.
2Q	780/790	n.a.
1Q	780/790	n.a.
1988		
4Q	730/740	675/700
3Q	730/740	n.a.
2Q	665/700	n.a.
1Q	625/660	n.a.
1987		
4Q	625/660	625/650
3Q	600/645*	n.a.
2Q	590/645*	n.a.
1Q	570/625*	n.a.
1986		
4Q	570/625*	556
3Q	570/625*	n.a.
2Q	550/600*	n.a.
1Q	(500/590)	n.a.
Year end		
1985	(500/590)	507
1984	590/665*	584
1983	590/625*	565
1982	590/625*	507
1981	625	584
1980	550	565
1979	490	570
1978	425/445	581
1977	405	482
1976	385	457/468
1975	360/365	406
1974	360	386
1973	300	364
1972	265	342

Note: Prices generally higher on the West Coast.
*Discounting from list prices reported.
n.a. = Not available.
( ) = Indicates estimated transaction prices where most volume is moving significantly below list.
Source: *Pulp & Paper Week.*

introduction about five years ago. Estimates place the number of aseptic cartons sold in the U.S. at between 4.5 and 5.0 billion units in 1988. However, the volume of liquid packaging board used for such aseptic packaging in the U.S. is still small, and most requirements are imported from Scandinavian producers. The preference for imports reflects the fact that the largest aseptic packaging converter in the U.S. is a subsidiary of AB Tetra Pak, a $2-billion Swedish company with an estimated 90% share of the world market.

AB Tetra Pak has installed nearly 5,800 proprietary packaging machines in 102 countries, and it operates 26 packaging material factories, six machine assembly plants, and 47 marketing companies worldwide. In 1988, some 50 billion Tetra Pak cartons were produced, equal to about 135 million cartons/day.

Aseptic cartons use advanced coextrusion technology to produce a shelf-stable package requiring no refrigeration to retain product freshness and quality. The cartons combine specially treated paperboard with plastic film and aluminum foil or other combinations. It is not necessary to use solid bleached board in this configuration. In fact, most of the Tetra Pak cartons use a multi-ply sheet with a middle ply of unbleached kraft pulp.

Aseptic packaging systems require sterilization and an extremely clean working site. The aseptic packaging laminate is sterilized either with a special hydrogen peroxide bath, high heat, or steam. After filling, the cartons require little or no refrigeration. They have greatly extended shelf life, and they are compact and convenient to carry and store. In short, the package is designed to save more than it costs to produce. Aseptic containers are used to package soft drinks, juices and juice concentrates, gelled foods, baby foods, sauces, pastes, gravies, and puddings. Attempts have been made to market aseptically packaged milk in the U.S., but dairies have difficulty breaking consumer perceptions that milk must be refrigerated to remain fresh.

Aseptic packaging was developed in Europe and approved by the U.S. Food and Drug Administration in 1982. Most aseptic packaging comes from its original inventor, Sweden's AB Tetra Pak. Its U.S. subsidiary, based in Texas, is Brik Pak Inc. Combibloc Inc., controlled by a West German company, is the second-largest manufacturer, followed by a relative newcomer, International Paper.

In 1987, IP entered into a joint agreement with SIG Swiss Industrial Co. to market in North America the new SIG high-speed aseptic packaging system. Since then, IP has developed a special Barrier Pak multilayer paperboard for use in aseptic packaging, and it produces this packaging at a new, state-of-the-art facility in Raleigh, N.C. This facility can produce a five-layer cold-fill or six-layer hot-fill coextruded sheet. IP now sells its aseptic board in over 20 countries. The bleached paperboard is supplied by the company's mills at Pine Bluff, Ark., Texarkana, Texas, and Balstrop, La.

Forecasts of aseptic packaging growth in this country are very optimistic. In a 1986 report, for example, Business Communications Co. (BCC) projected an annual growth rate of 10% for the aseptic food and beverage market during the following ten years. Total production of aseptic food/beverage containers was expected to reach 12.2 billion units in 1995, or about 4% of the entire food/beverage pack-

U.S. SANITARY FOOD CONTAINERS INDUSTRY: VALUE OF SHIPMENTS AND CONSUMPTION OF PAPER AND BOARD

	1982		1987	
	Paper and board consumed (000 short tons)	Value of products (million $)	Paper and board consumed (000 short tons)	Value of products (million $)
Total: (SIC Code 2654)	—[1]	$2,545.6	—[1]	$1,940.6
Milk and milk-type cartons[2]	569	550.0	526.5	557.5
Cups and liquid-tight containers	—	885.0	—	848.5
Liquid-tight containers[3]	32	64.0	24.2	61.3
Drinking cups[4]	451	821.0	459	786.6
Cups[5]	—	0.1	—	0.6
Other sanitary food containers[6]	—	356.0	—	457.9
Food serving products				
Stamped plates, dishes, spoons	227	259.0	202	273.2
Ovenable food trays	—	—	15	37.3
Other paperboard items	32	63.0	30	22.7
Other paper items[7]	—	—	—	112.4
Frozen foods and bakery[8]	196	229.0	297	360.0
Butter and ice cream packaging and food pails	155	170.0	209	258.2
Processed meats, margarine[9]	83	106.0	70	96.1
Others[10]	—	42.0	—	50.0

1. Data not collected or available.
2. Including juices, beverages, and other products.
3. Plus round nested food containers, including lids and tops.
4. Plus portion serving cups.
5. And liquid-tight containers not classified.
6. Includes food containers, boards, and trays.
7. Includes tablecloths and soda straws, except glass or plastic.
8. Including frozen bakery.
9. Plus lard and shortening.
10. For fresh meat, poultry, and produce for retail packaging.

Sources: 1982 Census of Manufactures, 1987 Census of Manufactures.

aging market. At the time of the report, aseptic containers totaled about 4.5 billion units annually, or 1.5% of the 313-billion-unit food/beverage market. Juices and juice products will remain the largest market segment through 1995, although other new products packaged aseptically will show higher real growth rates.

Aseptically packaged dairy products such as sour cream and individually packaged cream will gain wider acceptance over the next few years. But consumer preference for refrigerated milk will continue to thwart expansion of that product in aseptic packages, according to BCC. The BCC study noted that viscous and particulate products will be the most attractive new additions to the aseptic food/beverage line. The first real challenge to metal and glass packaging will occur during the late 1980s and early 1990s with the introduction of aseptic processing equipment and fillers that can preserve particle integrity, such as for soup.

Ovenable paperboard. The performance of ovenable paperboard, another innovative package system, has failed to match industry expectations, but it remains another leading-edge technology for the bleached paperboard industry. This type of paperboard, which can be used in both microwave and conventional ovens, has undergone many improvements in structure and design since its introduction in the 1970s. Ovenable paperboard is typically made by coating SBS with a polyethylene terephthalate (PET) resin and pressing or die cutting the SBS sheet into trays.

While use of microwave ovens has grown dramatically, current size of the ovenable paperboard market in the U.S. may still be less than 30,000 tpy, according to some estimates. One reason for the modest growth of ovenable paperboard is the development of an all-plastic tray that has been widely accepted by the frozen-food industry. Nevertheless, demand for ovenable paperboard grew at about a 6% annual rate during the past several years, according to the Dept. of Commerce. The increasing popularity of oven-ready meals and single-portion servings should continue to provide growth for paperboard in this market. Westvaco's Ovenware package, which goes directly from freezer to microwave or oven, has been accepted by consumers and packaged-food companies alike.

Food service disposables. As with liquid packaging, bleached board is facing heavy competition from plastics in the disposable-food-service segment. While dollar sales of converted trays, plates, cups, and nested and liquid-tight containers have remained fairly stable, unit volume of such paper products has probably declined, according to the Dept. of Commerce. In an attempt to counter competition from plastics, the industry has concentrated on improving the strength, appearance, and design of its cups and other food-service products. Companies have also emphasized paperboard's environmental benefits.

According to API statistics, production of bleached paperboard cups, plates, trays, and rounded nested food containers was relatively stable during the last decade. Production of bleached paperboard used to manufacture these products totaled 852,800 tons in 1989, which is about a 2.0% improvement from the year before. Paperboard disposables have enjoyed a small market share gain in the past few years because plastic disposables have been criticized as damaging to the environment.

Regardless of the environmental issues, plastic disposables have captured about 60% of the beverage cup market and an even higher share of the plate market, according to some industry estimates. Weak plastic resin prices in 1985-86 helped some integrated resin producers such as Mobil Corp. and Amoco Corp. gain market share, but the run-up in plastic resin prices that began in 1987 reduced their profits for these products. In general, plastic food-service products cost 25% to 30% less than their paper counterparts. PE-coated paperboard has best held its market share in the larger-size cold-service cups, while plastic foam cups and trays have made their largest inroads in the hot-service area. Plastic has also made significant gains in nested and other liquid-tight containers. Thermoformed plastic containers, for example, have taken over much of the market for dairy products such as cottage cheese and yogurt.

Plastic food-service disposables have drawn the wrath of environmental activists because they are neither biodegradable nor widely recycled and because toxic byproducts are produced during their manufacture. Although the plastic industry has responded by changing the chemical composition of its products and by recycling more of its waste, many communities and state governments still want to ban

FLUID MILK SALES BY PACKAGE SIZE AND TYPE*

Container size	Total sales (million lb)	Type of container (% of total sales) Glass	Paper	Plastic
Gallon	2,112.9	<0.1%	1.4%	98.6%
Half-gallon	732.2	1.1	71.3	23.6
Quart	163.4	1.1	96.8	2.1
Pint	60.8	<0.1	97.5	2.5
Half-pint	334.2	<0.1	99.3	0.7

*Sales for November 1987 by handlers regulated in Federal Milk Order markets. Represents 75% of U.S. handlers.
Source: U.S. Dept. of Agriculture.

PERCENT OF FLUID MILK SALES* BY PACKAGE TYPE

Year	Glass	Paper	Plastic	Other
1987	<0.5%	33%	67%	<0.5%
1985	<0.5	35	65	<0.5
1983	<0.5	38	62	<0.5
1977	1.0	58	41	<0.5
1971	7.0	78	15	<0.5
1966	25.0	67	6	2.0
1963	32.0	63	n.a.	5.0

n.a. = Not available.
*Represents total fluid milk, including whole, lowfat, and skim.
Source: U.S. Dept. of Agriculture.

the products. In the short term, this should increase demand for paperboard disposables.

Temple-Inland Forest Products Corp. (formerly Temple-Eastex Inc.) is the largest producer of cup and plate stock, but it has no converting facilities and sells all of its mill production to independent converters. James River is the major integrated producer of both paper and plastic food-service products through its Marathon and Dixie lines. Federal Paper Board sold its plate-converting operations to the Fonda Group in 1985, but Federal reentered the business in 1989 when it purchased Imperial Cup Corp. In 1990, Federal acquired the assets of Continental Bondware, a major producer of paper cups and disposables. Similarly, Scott Paper purchased Texstyrene Corp.'s disposable polystyrene cup business in 1988 and Cross Paperware in 1989. Fort Howard Corp. was formerly the largest independent converter and marketer of disposable paper and plastic products through its Maryland Cup and Lily-Tulip operations, but these businesses were sold to Silgan Corp. in 1989.

CONVERTED BLEACHED BOARD PRICES

(BLS price index)

Year	Milk and milk-type containers[1]	Cups and liquid-tight containers[2]	Bleached packaging and industrial converting paperboard[3]
1989			
4Q	375.4	135.2	135.4
3Q	377.0	135.3	134.5
2Q	362.5	129.3	130.1
1Q	355.0	129.6	129.8
1983			
4Q	349.4	121.2	122.8
3Q	354.1	113.4	115.5
2Q	345.6	113.3	113.6
1Q	339.5	109.3	106.9
1987			
4Q	334.7	109.3	106.9
3Q	336.8	109.3	106.8
2Q	337.5	106.7	107.3
1Q	332.9	105.2	108.7
1986			
4Q	334.3	105.0	108.3
3Q	336.6	102.0	107.3
2Q	332.7	100.6	106.2
1Q	333.3	100.1	105.9
Year end			
1985	335.9	100.2	107.7
1984	314.0	231.0	109.3
1983	302.5	220.0	103.0
1982	275.8	220.0	—
1981	257.5	220.0	—
1980	220.8	197.1	—
1979	199.0	180.1	—
1978	185.0	148.1	—
1977	180.7	140.2	—
1976	169.3	132.6	—
1975	157.7	126.7	—
1974	145.0	125.6	—
1973	109.3	106.4	—
1972	106.7	103.3	—
1971	102.0	103.3	—
1970	99.8	98.8	—

n.a. = Not available.

1. Listed as "Milk Cartons, Gal." prior to July 1985.

2. June 1985 = 100; 1967 to June 1985 = 100 (per 1,000). Listed as "Paper cups, hot" prior to June 1985.

3. December 1982 = 100.

Sources: U.S. Dept. of Labor, Bureau of Labor Statistics, Producer Prices and Price Indexes.

OUTLOOK

Analysts expect the bleached board market to resume expansion as new production capacity is added in 1990-91. In 1988-89, most mills were fully sold out and turning away new business throughout the year. According to one analyst's estimate, SBS folding carton production will again exceed 2.0 million tons in 1991-92, after a weak performance in 1989-90 caused by supply constraints. Milk carton and food service disposables should increase to 1.5 million tons, and exports should increase to about 800,000 tons. Total SBS production is forecast to reach 4.7 million tons in 1991 and 4.8 million tons in 1992.

The long-term forecast for folding carton stock remains optimistic because of increasing demand for packaging and

SUMMARY OF SANITARY FOOD CONTAINER INDUSTRY STATISTICS (SIC Code 2654)

Year	Plants (total)	Employees	Value of shipments[1] (million $)	Capital expenditures (million $)
1987	92	16,900	$2,192	$97.3
1986	—	24,700	2,934	142.6
1985	—	23,400	3,014	112.5
1984	—	22,800	2,944	64.6
1983	—	23,600	2,912	78.5
1982	145	24,600	2,826	67.1
1981	—	28,300	2,842	70.7
1980	—	28,400	2,900	56.0
1979	—	29,800	3,196	65.7
1978	—	28,900	3,161	71.5
1977	193	28,700	3,258	52.4
1976	—	30,600	3,330	53.8
1975	—	28,300	3,151	29.6
1974	—	—	3,365	44.5
1973	—	—	3,424	38.0
1972	251	35,100	3,461	42.3
1971	—	—	—	33.8
1970	—	—	—	39.8

1. Value of industry shipments, not products, in 1982 dollars.

Source: Census of Manufactures.

increasing emphasis on printing and graphics. The continuous introduction of new consumer products spurs demand for folding cartons. Although food packaging remains the largest market for folding cartons, market growth is also coming from consumer electronic products, video and computer software packaging, etc. In addition, the increase in microwave oven sales has expanded the market for prepared microwave foods, which are mostly packaged and sold in folding cartons. Greater emphasis on personal health has opened up new packaging opportunities in health foods and over-the-counter medicines. The explosion in consumer electronic products will also fuel demand for cartons.

Provided that consumers continue spending approximately the same amount of their income on packaged foods and disposable food-service products, the Dept. of Commerce expected the real value of sanitary food container shipments to climb about 2% in 1990—about the same as in 1989. Sales of paperboard milk cartons were expected to increase slightly during 1990 at the expense of plastic containers—the result of expansion into new markets. Sales of aseptically packaged juices and other drinks were expected to continue expanding; however, aseptic milk shipments should grow more slowly, constrained by hard-to-change consumer buying habits and tastes, according to the Dept. of Commerce.

For the 1987-91 period, the Dept. of Commerce's forecast calls for an average annual growth rate of about 2.2% for sanitary food container shipments, provided there is gradual improvement in retail food sales as well as continued growth in fast foods and convenience foods.

Aseptic and microwave containers will continue to be the packaging industry's growth leaders. New food-packaging materials will appear, especially barrier plastics (coextruded, multilayer plastic containers that extend nonrefrigerated shelf life for a variety of food products such as juices and sauces) and retortable, flexible, food-filled plastic bags, which also extend nonrefrigerated shelf life and are especially geared to packaging solid foods.

Plastics will play an increasing role in the construction of the aseptic package, sometimes displacing paperboard and foil completely. Sales of ovenable paperboard trays will continue rising, but plastics will likely provide increasing competition in this packaging sector.

Export shipments of U.S. bleached board should continue growing faster than domestic demand. However, increased use of aseptic packaging in various parts of the world may favor Scandinavian producers, particularly in Europe. Most future growth for U.S. exports will be in Asia, which now accounts for about 70% of U.S. milk carton shipments.

Paperboard:

RECYCLED

Recycled paperboard typically consists of 100% wastepaper fiber and is produced on either a multiformer or fourdrinier paper machine. Recycled mills tend to be older, smaller, and less efficient than those found in other sectors of the industry, but this trend is changing as companies invest in capital improvements. The average size of recycled paperboard machines in the U.S. is about 140 tpd compared with about 490 tpd for solid bleached and 750 tpd for unbleached kraft board. However, recycled mills are usually located closer to their customers and fiber sources, thereby reducing shipping and materials costs and enabling them to provide quick response to customer needs.

Recycled paperboard includes such diverse grades as boxboard, containerboard, gypsum linerboard, and various types of industrial converting grades. Production capacity by major grade in 1989 breaks down as follows: folding boxboard, 26.8%; setup boxboard, 2.8%; corrugating medium, 19.4%; gypsum linerboard, 14.6%; linerboard, 6.2%; container chip and filler board, 0.5%; and other converting grades, 29.7%. The converting grades include nonpackaging and miscellaneous end uses such as tube, can, drum, tag, file folder, match stem, tablet backs, book cover, and game boards. Not included are various types of construction paper and board (except for gypsum wallboard liner).

Boxboard grades usually consist of four or more plies. The top layer is made from deinked pulp or other high-quality wastepaper, such as one of the pulp substitutes. Middle plies are made with lower-quality paper stock, such as old news and mixed papers combined with some old corrugated containers for added strength. The fiber content of the bottom layer (or back ply) depends on the strength and appearance preferred in the finished product. Fiber choices include news, corrugated, and pulp substitutes.

Overall demand for recycled paperboard grades is growing slowly due to competition from virgin grades, plastic packaging, and declining end-use markets. Production during the last decade grew at an average rate of 1.7%. The fastest growth was in clay-coated boxboard grades, containerboard, and gypsum linerboard—a trend that is expected to continue. At the same time, uncoated chipboard, setup boxboard, and some miscellaneous uses have declined.

The combination of slow growth in many mature markets and rising energy and fiber costs caused several recycled mills to shut down in the 1970s. The industry has also undergone a major period of consolidation during the past two decades. More capacity was retired from recycled paperboard than from any other sector of the industry, with over 2.7 million tons, or 34% of recycled paperboard annual capacity, taken out of production in the 1970s. Machine rebuilds offset the losses, however, keeping capacity relatively stable.

Between 1977 and 1986, recycled board capacity increased just 176,000 tons for an average annual growth rate

U.S. STATISTICS FOR RECYCLED BOXBOARD AND PAPERBOARD

	1990e	1989	1988
Production, 000 tons[1]	8,615	8,754	8,789
Capacity, 000 tons	10,029	9,612	9,532
Utilization rate, %	85.9	91.1	92.2
Imports, 000 tons	85	100	95
Exports, 000 tons	44	34	72
Apparent U.S. consumption			
000 tons	8,656	8,820	8,812
lb/capita	69.25	71.74	71.85
000 tons/billion $ real GNP (1982)	2.20	2.25	2.25

e = Estimate.

[1] All tons are short tons.

Sources: American Paper Institute, *Pulp & Paper* estimates.

of 0.2%, according to the American Paper Institute. Much of this additional capacity resulted from the startup of Inland Container Corp.'s new 175,000-tpy Ontario, Calif., recycled linerboard mill in 1985.

Despite the removal of 100,000 tons of annual capacity in 1986 due to an idled mill, recycled board capacity rose 457,000 tons between 1985 and 1987—a 5.2% increase. Capacity climbed again in 1988 and 1989, reaching 9.6 million tons in 1989. The projected increase in capacity for recycled paperboard for 1990-92 is more than double the increase during the previous three years. Current producers as well as new entrants into the industry will add 1.193 million tons of capacity to the 1989 base. Containerboard grades will account for 75%, or 944,000 tons, of the new capacity.

A good part of this future capacity growth will come from the restart of several idle paper mills to produce recycled paperboard grades, as well as more than 20 separate machine rebuilds and capacity expansions across the U.S. The resurgent demand for certain recycled packaging grades combined with the increasing need to reduce solid waste will sustain capacity growth in the next few years.

INDUSTRY STRUCTURE

Several companies, such as Jefferson Smurfit Corp., Newark Group Inc., Sonoco Products Co., Caraustar Industries Inc., and Rock-Tenn Co., have expanded their positions in the industry, while others have sold off or closed their recycled board mills. Headquartered in St. Louis, Mo., Jefferson Smurfit is by far the largest player in the industry, with 1.33 million tons of annual capacity. It purchased 50% ownership of Container Corp. of America in 1986 and manages all of CCA's operations in the U.S. Jefferson Smurfit's other major acquisitions included Alton Packaging Corp., two boxboard mills from Diamond International Corp., and one mill from Union Camp Corp.

RECYCLED COMBINATION PAPERBOARD, BOXBOARD, AND PACKAGING GRADES

- Album board
- Automobile board
- Bending chipboard
- Blister board
- Can stock
- Car lining board
- Chipboard
- Cracker shell board
- Core stock
- Corrugating medium
- Drum stock
- Florist board
- Innersole
- Jute board
- Kraft-backed board
- Laminating board
- Lined board
- Manila board
- Matchbook board
- Mat-finishing board
- Moistureproof board
- Mounting board
- Newsboard
- Offset blanks
- Patent-coated
- Pasteboard
- Photo-mount board
- Poster board
- Pulpboard
- Saturating board
- Shoeboard
- Test chipboard
- Test linerboard
- Transformer board
- Tube stock
- Wallboard
- Water-resistant board
- Waterproof board
- Wet-strength board
- White-lined board

The New Jersey-based Newark Group is the second-largest manufacturer of recycled paperboard products in the U.S., operating 11 paperboard mills nationwide with total capacity of about 875,000 tpy. Its recent acquisitions include Federal Paper Board Co.'s Los Angeles, Calif., recycled mill and National Gypsum Co.'s Stockton, Calif., mill.

Sonoco Products is the third-largest recycled paperboard producer, with an estimated 850,000 tpy of capacity. In 1987, the company bought Boise Cascade Corp.'s Consumer Packaging Div., making it the country's largest producer of composite cans, tubes, and cores. In 1988, the company purchased Federal Paper Board's Richmond, Va., recycled board mill to supply its own core, tube, and drum manufacturing plants with lightweight paperboard.

Similar industry consolidation occurred in Canada when Paperboard Industries Corp. of Toronto, Ont., acquired Belkin Inc. of Vancouver, B.C. The combined company is by far the largest recycled paperboard producer north of the U.S. border, with an estimated 550,000 tpy of boxboard and containerboard production capacity at six mills.

Mead Corp. and Packaging Corp. of America both put their recycled board mills up for sale in 1987. PCA reached a tentative agreement to sell its recycled business to Republic Gypsum Co., but the deal later fell through, and PCA decided to keep the mills. Mead, however, successfully completed the sale of its recycled division (consisting of three mills) to Rock-Tenn in 1988. In 1989, Boise Cascade Corp. sold its specialty paperboard division to a private investment group, Specialty Paperboard Inc., and retained a 30% equity interest in the new company. The transaction included four mills in New York and Vermont that produce a variety of chipboard and pressboard grades used in the manufacture of book covers, office supplies, graphic arts, and specialty boxboard.

One of the largest reductions in U.S. recycled board capacity occurred in 1980 when Whippany Paper Board Co. declared bankruptcy, idling 450,000 tpy. Some of the former Whippany mills have been sold and have reopened under new ownership. Whippany's Clifton, N.J., mill was

TYPICAL GRADE STRUCTURE FOR TEST LINERBOARD

Basis weight[1] (lb/1,000 ft^2)	Caliper[1] (0.001 in.)	Mullen[1] (psi)
42	12	80-85
47	13	90
48/52	13/15	95/100
69	19	130

1. Tests are approximate. These grades supplied in other weights and at different levels of mullen.

sold to V. Ponte & Sons, a wastepaper dealér, which formed a new company, Recycled Paperboard Inc., to rebuild the mill's cylinderboard machines to produce chipboard grades beginning in mid-1990. The former bankrupt Morris Paperboard mill in Paterson, N.J., was purchased in 1986 by People's Rep. China's National Packaging Corp. and reopened to produce mostly recycled linerboard. The mill was subsequently closed in 1988 and sold to Paper Board Specialties Inc., which planned to reopen the mill in mid-1990.

As a result of such activities, industry concentration increased significantly over the past decade. The total market share held by the ten largest U.S. recycled board producers grew from 42% in 1978 to approximately 60% in 1989.

The competitiveness of recycled paperboard mills continues to be affected by high energy costs (because these mills rely largely on purchased energy and have no spent pulping liquors or woodwastes to burn) and fluctutations in wastepaper costs. In 1986-87, wastepaper fiber prices skyrocketed, but prices for recycled paper products remained flat, so profits were substantially depressed. Conversely, when wastepaper prices are depressed due to oversupply, recycled mills have a cost advantage over kraft grades because their raw material costs are extremely low. This is the scenario that developed during 1988-89.

Operating rates at recycled paperboard mills have improved steadily in recent years, rising from 86.8% in 1985 to approximately 92.7% in 1989.

RECYCLED FOLDING CARTON

Production of clay-coated recycled folding carton was approximately 1.7 million tons in 1989. Other recycled folding boxboard grades, such as uncoated bending chipboard and white-lined grades, account for a smaller amount of total recycled folding boxboard—about 680,000 tons in 1989. Production of recycled boxboard for folding cartons has increased about 100,000 tons in the past several years, resulting mostly from machine rebuilds and incremental capacity increases in the industry.

Recycled folding carton grades are produced in calipers ranging from 16 to 28 pt and in basis weights ranging from about 66 to 110 lb/1,000 ft². Sheet density is the basis weight divided by the caliper. A typical clay-coated recycled folding carton grade is 16- to 20-pt caliper and 66 to 82 lb/1,000 ft².

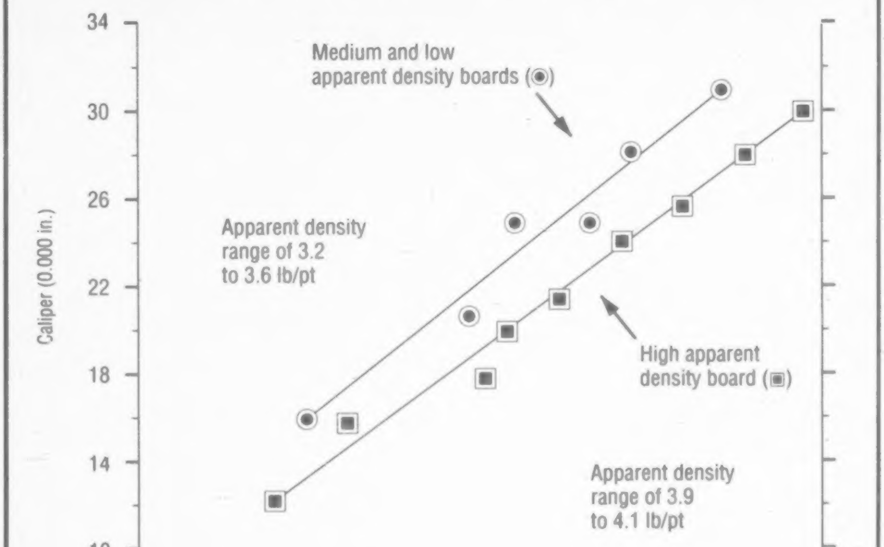
The remainder of the folding carton market consists of solid bleached sulfate (SBS) kraft and unbleached kraft grades. API said that recycled paperboard's share of the domestic folding carton market dropped from 49.3% to 44.4% between 1978 and 1989 and has now stabilized. At the same time, unbleached kraft's share rose from 13.1% to 18.4%, while SBS's share remained relatively unchanged at about 38%.

Total folding carton shipments measured in tons increased about 4.0% annually from 1986 to 1988 but began slowing in 1989, according to the Paperboard Packaging Council. Since 1989, sales volume has outpaced tonnage shipments. The strong growth in folding cartons can be explained by the strong growth pattern in U.S. consumer spending in most of the 1980s. The recent strength in folding carton markets has been sustained by new products such as videocassettes, compact discs, and other electronic products.

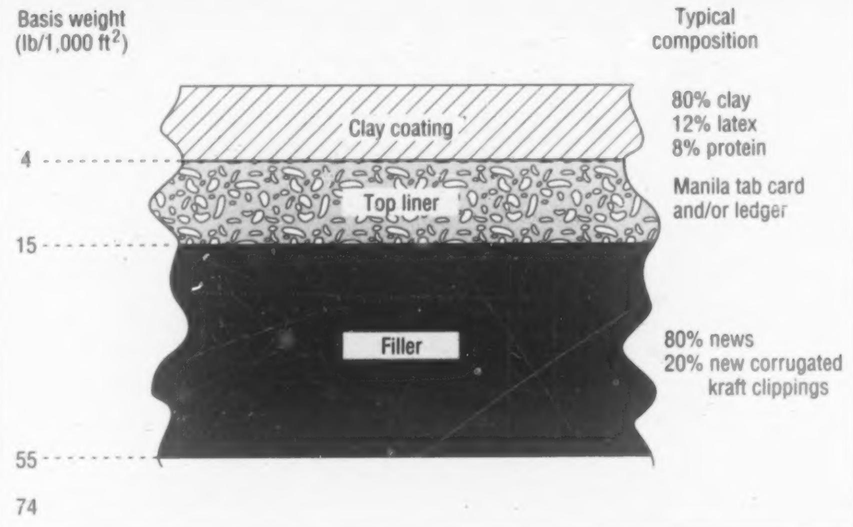
It is likely that the current growth rates for folding cartons will be lower than the historical trend because demand is highly dependent on consumer spending, which was weakening in mid-1990. The annual growth rate over the next few years will likely drop to about 1.5% to 2.0%, according to one industry estimate.

TYPICAL GRADE STRUCTURE FOR BOXBOARD GRADES

(approximate relation between caliper and basis weight for high- and low-density boards)



COMPOSITION OF 18-POINT CLAY-COATED FOLDING BOXBOARD


Basis weight (lb/1,000 ft²)
Typical composition
Clay coating
80% clay
12% latex
8% protein
4
Top liner
Manila tab card and/or ledger
15
Filler
80% news
20% new corrugated kraft clippings
55
74

U.S. PRODUCTION OF BOXBOARD GRADES—FOLDING AND SETUP

(000 short tons)

Year	Total folding	Recycled folding boxboard[1] Unlined chipboard	Kraft lined	White lined	Clay coated	Total setup boxboard[2]
1989	2,564	562	113	142	1,747	292
1988	2,589	556	137	140	1,756	300
1987	2,561	537	162	130	1,731	240
1986	2,284	441	219	168	1,456	273
1985	2,268	468	203	193	1,404	259
1984	2,310	471	168	224	1,447	307
1983	2,369	585	180	227	1,377	263
1982	2,152	546	146	152	1,308	238
1981	2,425	n.a.	176	189	n.a.	298
1980	2,350	606	81	220	1,443	560
1979	2,386	678	98	229	1,380	604
1978	2,469	706	131	247	1,384	687
1977	2,423	687	133	274	1,330	717
1976	2,508	707	145	313	1,343	747
1975	2,108	564	124	274	1,146	672
1974	2,423	697	137	439	1,149	796
1973	2,652	740	146	520	1,246	998
1972	2,656	793	140	533	1,190	985
1971	2,575	n.a.	n.a.	n.a.	n.a.	979
1970	2,727	n.a.	n.a.	n.a.	n.a.	1,042
1969	2,852	n.a.	n.a.	n.a.	n.a.	1,164

n.a. = Not available.
1. Bureau of the Census defines as combination bending board.
2. Bureau of the Census defines as combination nonbending board. These boards are used to produce rigid paperboxes, among other uses.
Source: Bureau of the Census.

Grade competition. The popularity of coated SBS kraft grades has been undermined by its high prices compared with clay-coated recycled grades and unbleached kraft grades. The price differential between SBS and clay-coated recycled newsback (CCN) folding carton board reached an unprecedented level of $300/ton in 1989. Prices for 20-pt CCN reached $480/ton in 1989 vs $780/ton for 15-pt SBS. Kraftback recycled grade prices were about $510/ton. In third-quarter 1989, SBS producers pushed prices to $830/ton, and in first-quarter 1990, CCN prices climbed to $515/ton, and kraftback recycled grades increased to $545/ton. Unbleached kraft folding carton board prices currently fall in between, at about $620/ton.

Clay-coated recycled boxboard, which is typically coated on only one side with on-machine coaters, is primarily used to package nonfood products such as soaps and detergents, hardware, toys, and lower-priced cosmetics and toiletries. It is also used with some dry foods such as cookies, cereal, and biscuits that are first packaged in a plastic bag or inner liner to eliminate direct food contact with the carton. Waxes, polyethylene, and other special coatings may be applied to the carton surface to give the package special barrier properties. Clay-coated newsback is readily identifiable by the gray appearance of its unprinted side. Boards that have a kraft backing are identified by their brown, unprinted side.

Quality and productivity have been upgraded at most recycled paperboard mills that produce the folding carton grades. Older cylinderboard machines have been rebuilt and equipped with new headboxes, multi-ply forming sections, and press sections. Innovations such as Kobayashi Engineering's Ultra Former, the Inverform process, and Black Clawson Co.'s pressure formers have allowed improved cylinder forming on these machines and enable mills to compete more effectively with coated solid bleached and unbleached boards, which are the major competitors of recycled folding boxboard. A lower-density sheet can be produced on these advanced formers more effectively than on conventional cylinderboard machines—between 3.9 to 4.2 lb/pt on traditional cylinderboard machines vs 3.4 to 3.8 lb/pt on newer formers.

Most of the industry's older cylinderboard machines, which have not been upgraded to produce premium white clay-coated folding carton board, generally produce lower-grade bending boards and nonbending grades of boxboard.

The uncoated bending grades have suitable folding capabilty and printing surface appropriate for pizza boxes, paper clip boxes, etc. Prices of nonbending board averaged about $340/ton in 1989 and increased to $365/ton in the first quarter of 1990. The nonbending grades are used primarily in the manufacture of setup boxes and other products where stiffnes and rigidity are important, and they are priced by specific use.

RECYCLED SETUP BOXBOARD

Rigid boxes, book binding board, and other forms of packaging are the primary uses for setup boxboard, also called nonbending chipboard. Grades include plain chipboard, news vat-lined chip, filled news, and white vat-lined chip. Generally, plain chip is made from mixed wastepapers; news vat-lined has one side lined with old newspapers (ONP) to give it a smooth, clean appearance; filled news is lined on both sides with ONP; and white-lined has a white surface on one side, resulting from the use of higher grades of wastepapers. These grades can be pasted or laminated to form nonbending boards of greater thickness. Plain setup chipboard is usually overwrapped with specialty grades of decor paper to create an attractive box or book binding. Rigid boxes are commonly used for candy, stationery, jew-

U.S. PRICES FOR RECYCLED BOXBOARD GRADES

($/short ton)

Year	20-pt clay-coated 80 bright (rolls)	20-pt chipboard bending (rolls)
1990		
2Q	$515/545	$365
1Q	515/545	365
1989		
4Q	480/510	340
3Q	480/510	340
2Q	480/510	340
1Q	480/510	340
1988		
4Q	450/475	340
3Q	440/460	340
2Q	410/430	340
1Q	410/430	320
1987		
4Q	380/400	320
3Q	380/400	320
2Q	355/375	320
1Q	355/375	320
1986		
4Q	380/420*	320*
3Q	370/410*	310*
2Q	370/400*	300*
1Q	350/400*	300*
Year end		
1985	350/400*	300*
1984	370/425*	300*
1983	370/425*	280/300*
1982	380/425*	280*
1981	400/425*	270/280*
1980	380	275
1979	355	260
1978	305	225
1977	284	219
1976	262	212
1975	257	204

*Discounting reported from list prices. Prices on both grades highest on the West Coast and lowest in the Midwest, except for 1987 when prices in the East were lowest.

Source: *Pulp & Paper Week.*

elry, toiletries, and recently even computer software. Nonbending chipboard is also used in the manufacture of game boards and book bindings.

Setup boxboard is usually made from wastepaper of a lower grade than that used for folding cartons because bending and scoring requirements are not very important for setup boxes. Setup boxboard grades are generally produced in the 20-to-65-pt caliper range. Higher-caliper grades ranging from 60 to 150 pt can be produced by pasting lower-caliper grades together.

The traditional rigid box is much more expensive to produce than a folding carton because it is often custom-designed to hold a specific product and its manufacturing is more labor-intensive. Therefore, it is typically used to package expensive goods in uniquely designed boxes that reflect the product's high quality.

Demand for rigid boxes has decreased from a peak of about 600,000 tons annually in the 1950s to about 280,000 tons in 1989. Competition from folding cartons, the substitution of plastics, and new packaging methods have steadily eroded the setup box market. There is also less demand for some products formerly packaged in rigid boxes, such as men's and women's hats. Demand has been stable in recent years, and the trend is forecast to continue in the next few years. Declining demand for setup boxes also caused a significant amount of attrition and consolidation among traditional setup box manufacturers, but the market has stabilized in recent years.

The industry is moving ahead by cutting costs and boosting productivity, diversifying its product mix, and opening new market areas. Converters have improved product design, appearance, graphics, and color printing through use of better inks and ink-curing processes, as well as through new processing and coating techniques that improve strength and moisture resistance of rigid boxes.

Such moves should help setup boxes carve out a bigger niche in the market for special-purpose, higher-value packaging. The Dept. of Commerce forecast about a 1.5% annual rise in the real value of setup paperboard box shipments between 1987 and 1991. Cosmetics, pharmaceuticals, confectionery, and electronics are expected to be growth areas for this custom packaging.

Competition will persist from other packaging, especially folding cartons and molded plastic containers, but setup board should retain most of its current market share for specialty packaging.

CONTAINERBOARD

Recycled containerboard grades—linerboard and corrugating medium—are produced on fourdrinier or cylinder-board machines. Recycled linerboard, also known as test linerboard, and corrugating medium are typically made from a furnish consisting mostly of old corrugated containers

U.S. PRODUCTION OF RECYCLED SHIPPING CONTAINERBOARD GRADES

(000 short tons)

Year	Total	Liner-board	Corrugating medium	Chip and filler boards
1989	3,090	848	2,044	198
1988	3,151	917	2,034	200
1987	3,131	1,029	1,950	152
1986	2,495	761	1,568	167
1985	2,560	918	1,486	157
1984	2,407	846	1,397	164
1983	2,565	879	1,519	167
1982	2,087	504	1,427	165
1981	1,750	250	1,315	185
1980	2,070	518	1,281	271
1979	2,050	460	1,301	290
1978	1,981	332	1,408	242
1977	1,908	379	1,286	243
1976	1,470	227	1,040	202
1975	1,129	196	788	145
1974	1,766	454	1,114	198
1973	1,741	295	1,204	241
1972	1,476	279	942	255
1971	1,390	263	879	248
1970	1,522	321	916	285
1969	1,624	402	939	283

Source: Bureau of the Census.

CANADIAN PRODUCTION OF BOXBOARD GRADES

(000 metric tons)

Year	Folding	Nonfolding	Other*	Total
1989	465	56	208	729
1988	424	61	238	723
1987	435	63	244	742
1986	331	97	298	726
1985	324	94	279	697
1984	329	129	299	757
1983	322	116	268	704
1982	277	104	245	627
1981	300	118	298	716
1980	281	107	292	680
1979	286	108	338	731
1978	247	121	321	689
1977	216	121	280	617
1976	203	73	247	525
1975	174	92	216	482
1974	231	129	288	647
1973	242	96	274	612
1972	248	86	271	605
1971	238	91	240	569
1970	234	93	243	570
1969	239	95	248	582

*Includes liner for gypsum or plaster board, and mill wrapping.
Source: Canadian Pulp & Paper Assn.

(OCC). Linerboard is manufactured to a specific burst or mullen strength (e.g., 95 to 100 psi to be equivalent to 42-lb linerboard produced from virgin kraft fiber).

A recycled mill usually produces a higher sheet weight in order to make test linerboard equivalent to virgin linerboard. For example, a 100-lb test linerboard might have a basis weight of 48 to 50 lb/1,000 ft², compared with 42 lb/ 1,000 ft² for virgin linerboard.

Recycled linerboard production doubled between 1984 and 1988, reaching slightly over 400,000 tons in 1988. But demand dropped sharply in 1989 and through mid-1990 because of weakening linerboard markets. Recycled linerboard supplies only about 3.0% of total domestic linerboard demand, but this figure should increase to about 5.0% during 1991-92 as more producers use wastepaper in their fiber furnish. Demand for recycled linerboard is strongest when the kraft linerboard market is tight, but demand can fall off sharply during an economic downturn.

Production of recycled linerboard is expected to increase in the U.S., principally due to the increasing public demand for more recycling and the low capital cost of installing new recycling capacity. Capacity of recycled linerboard and corrugating medium will also increase sharply in the next few years because several new greenfield mills are being proposed for startup beginning in 1992.

Recycled corrugating medium is more accepted in the U.S. as a substitute for semichemical medium, a trend that has fueled a sharp increase in capacity. Recycled corrugating medium accounts for about 25% of the 7.0 million tons of corrugating medium consumed in the U.S. annually.

Major producers of recycled medium and linerboard include Inland Container Co., Jefferson Smurfit Co., Gaylord Container Corp., Chesapeake Corp., Virginia Fibre Corp. Menominee Paper Co., and Stone Container Corp. In Canada, Paperboard Industries and Cascades Inc. are the major producers of recycled containerboard. In late 1988, Nolichucky Industries Corp. declared bankruptcy, resulting in the shutdown of about 180,000 tons of recycled containerboard production capacity at three mills. Two foreign firms—Australia's Pratt Group and Japan's Daishowa Paper Manufacturing Co.—have expanded into recycled containerboard production in the U.S.

RECYCLED INDUSTRIAL/CONVERTING PAPERBOARD

Gypsum linerboard, used as the front and back liners for gypsum wallboard, is generally made by large, integrated producers of construction papers and board. Major producers include U.S. Gypsum Co., National Gypsum, Georgia-Pacific Corp., Celotex Corp., Republic Gypsum, and Domtar Inc.

Nonintegrated producers, however, may sell small amounts. Recently, both National Gypsum and U.S. Gypsum sold recycled paperboard mills that produce gypsum linerboard. Demand for gypsum linerboard is closely linked to demand for wallboard. As a general rule, about 50% of gypsum wallboard is used in construction of new family housing, 20% in nonresidential buildings, 20% in repair and remodeling, and the remaining 10% in other uses.

Because few products offer comparable value at such low prices, the market is expected to stay strong in the long term. In the short term, however, demand may fluctuate significantly because it follows the general construction and housing market and interest rates. During 1984-89, U.S. production fluctuated between 1.1 and 1.3 million tons/ year.

Tube, can, core, and drum products comprise one of the largest markets for recycled paperboard. These end uses

U.S. PRODUCTION OF SPECIAL RECYCLED PACKAGING AND INDUSTRIAL CONVERTING PAPERBOARDS

(000 short tons)

Year	Total	Gypsum linerboard	Tube, can, and drum stock	Panelboard wallboard stock	Others
1989	3,099	1,198	1,146	23	732
1988	3,129	1,239	1,151	35	704
1987	3,070	1,227	1,124	48	671
1986	2,950	1,145	1,043	64	698
1985	2,814	1,079	1,021	68	646
1984	2,772	915	1,064	150	643
1983	2,406	798	858	148	602
1982	2,119	750	767	119	635
1981	2,144	809	634	100	601
1980	2,262	1,036	564	113	548
1979	2,543	1,210	628	137	568
1978	2,453	1,185	601	119	546
1977	2,378	1,099	680	113	485
1976	2,205	963	701	86	454
1975	1,913	821	630	67	395
1974	2,228	960	733	67	467
1973	2,403	1,051	763	94	493
1972	2,278	1,053	728	117	380
1971	2,048	936	641	105	366
1970	1,739	807	573	90	270
1969	1,771	847	527	113	285

Source: Bureau of the Census.

consume about 15% of total recycled paperboard production, amounting to an estimated 1.3 million tons in 1989. Approximately 150,000 tpy of unbleached kraft paperboard and a small amount of semichemical paperboard are also used in these products.

The largest single market is fiber-based tubes, cores, and cones used for winding textiles, paper, plastic film, and cable. Industrial drums and containers is also a large market. Together, these industrial products account for about 70% of the volume.

The remaining 30% of the market is mostly composite cans used in consumer packaging for frozen juices, snacks, and a variety of dry foods.

The industry is highly integrated, with paperboard producers such as Sonoco Products and Jefferson Smurfit having converting operations at their own mills or nearby. Most mills and converting facilities are located near the industrial markets they serve because of high shipping costs on bulky cores, drums, or tubes. U.S. Paper Mills Corp., for example, specializes in supplying lightweight core stock to the many tissue and towel converting operations located in Wisconsin. Greif Bros. Corp., which owns no paper mills, is the largest independent converter of industrial fiber drums in the U.S.

Industry structure underwent a substantial shift during the 1980s. In 1982, Container Corp. of America and Owens-Illinois Inc. left the business. CCA sold its composite can division to Sonoco but retained its plastic drum business. Sonoco later added to that acquisition by buying Continental Fibre Drum Inc.'s 13 plants early in 1985, and it acquired Plast-Drum Inc. in 1986 to expand into plastic industrial drums. In 1987, Sonoco purchased the Consumer Packaging Div. of Boise Cascade, which included 27 composite can and/or plastic bottle plants.

Meanwhile, Jefferson Smurfit acquired CCA's plastic drum business in 1986, adding it to the industrial fiber drum business it acquired from Alton Packaging. Another major player in the market is Caraustar Industries' affiliate Star Paper Tube Inc., which bought Apache Products Inc. early in 1985, bringing the total number of its tube and core plants to 17. Later in 1985, Clevepak Corp. indicated it would sell its Container & Core Div. to an employee group.

While paperboard use in industrial tube, drum, and core products grew about 1.5%/year during the past decade, use of composite cans for packaging declined sharply. Virtually all motor oil packaging has shifted from composite cans to plastic containers, and much of the frozen juice concentrate market has changed to plastic containers as well.

The continuing downward spiral of composite fiber cans is the main reason for low growth in this segment. Competition from plastic cans, flexible plastic pouches, aseptic containers, and paperboard, metal, and glass containers

U.S. FOLDING BOXBOARD MARKET SHARE BY GRADE

(000 short tons)

		Recycled		Solid bleached sulfate (SBS)		Coated unbleached kraft	
Year	Total	Ton	Share	Ton	Share	Ton	Share
1989	5,360	2,381	44.4%	1,993	37.2%	987	18.4%
1988	5,292	2,352	44.4	2,016	38.1	924	17.5
1987	5,210	2,342	45.0	2,003	38.4	865	16.6
1986	5,056	2,256	44.6	1,911	37.8	889	17.6
1985	4,805	2,241	46.7	1,742	36.2	822	17.1
1984	4,876	2,277	46.7	1,847	37.9	752	15.4
1983	4,646	2,211	47.6	1,725	37.1	710	15.3
1982	4,334	2,076	47.9	1,567	36.2	691	15.9
1981	4,588	2,260	49.3	1,655	36.1	672	14.6
1980	4,490	2,234	49.8	1,575	35.1	680	15.1
1979	4,721	2,309	48.9	1,714	36.3	698	14.8
1978	4,702	2,321	49.4	1,763	37.5	618	13.1
1977	4,547	2,367	52.1	1,592	32.8	588	12.9
1976	4,715	2,340	49.6	1,797	38.1	578	12.3
1975	3,896	1,978	50.8	1,456	37.4	463	11.9
1974	4,427	2,281	51.5	1,676	37.9	470	10.6
1973	4,705	2,522	53.6	1,728	36.7	455	9.7
1972	4,440	2,477	55.8	1,573	35.4	390	8.8
1971	4,139	2,408	58.2	1,392	33.6	340	8.2
1970	4,080	2,473	60.6	1,263	31.0	343	8.4
1969	4,262	2,629	61.7	1,346	31.6	287	6.7
1968	4,218	2,730	64.7	1,227	29.1	261	6.2

Source: American Paper Institute.

caused sales of composite cans to drop an estimated 7.0% in volume in 1985-86. This compares with a loss of 8.5% during 1984-85, according to the Dept. of Commerce. Through 1987, the decline in the value of shipments of fiber cans, drums, and similar products eased slightly, falling only 3%. During 1987-91, the industry is expected to grow at an inflation-adjusted annual rate of 1%.

The composite fiber can sector will improve modestly, with increased shipments for such end uses as pet food, snack food, powdered drinks, frozen food, and nonfood containers. (See section on Converted Paper and Board.)

Basestocks for tube, core, and drum products are produced in a variety of basis weights and compositions. For cores, the principal test is crush resistance. Typically, an outer ply of virgin kraft paperboard in a 13-pt caliper range is used for core stock. The inner layers are made from semichemical furnish, high-yield kraft, or recycled furnish. In most cases, recycled paperboard cores use a 17-pt caliper core stock. In making core or tube stock, parent rolls are cut into rolls about 5 in. wide. Standard cores have a 3-in. diameter and varying wall thicknesses, with $^3/_8$-in. and $^1/_2$-in. wall thicknesses being common.

Panel and wallboard stocks are used to manufacture thick, rigid boards used in home construction, automobiles, and trailers. Basestock is produced on cylinder board machines and then pasted or laminated together to make panels or wallboards of different thicknesses. Wallboard and panelboard stocks are made by a limited number of producers. The long-term market for these grades is static, although demand tends to fluctuate with the levels of trailer production and new construction. Approximately 115,000 tons of recycled paperboard are used annually in these applications.

Other recycled paperboard includes a wide range of specialty board used in display boards, book bindings, game boards, etc. Specialty uses are expected to continue growing, although at a modest rate with limited production. These miscellaneous applications consume approximately 200,000 tons of recycled paperboard annually.

FORMING METHODS

During the last two decades, recycled cylinderboard grades lost much of their competitive advantage to fourdrinier board grades in folding carton packaging. On a fourdrinier paper machine, SBS boards can be produced at higher speeds and with somewhat lower density and machine-direction/cross-direction (MD/CD) stiffness or grain ratio than recycled paperboard grades. This improved board stiffness allows higher line speeds on carton filling machines. The fourdrinier, however, is limited in the caliper ranges that it offers. SBS boards are usually produced in calipers ranging from 10 to 28 pt, although they rarely exceed 20 pt.

Cylinderboard machines usually produce boards in calipers ranging from 16 to 45 pt, with most cylinder machines able to produce a wide range of combination paperboard, folding and setup boxboard, corrugating medium, gypsum linerboard, and chipboard.

The typical cylinder machine with an open stock flow system and conventional cylinder mold and vat forming system is limited in its performance. Because of the limitations of depending on centrifugal forces, it is difficult to operate a conventional cylinderboard machine at speeds over 600 fpm. The paperboard grades formed in this method will have a tensile ratio of 4:1 (MD/CD) and no better than 3:1.

In a conventional cylinder-forming system, the cylinder

U.S. AND CANADIAN CAPACITY FOR RECYCLED PAPERBOARD

(000 short tons)

	U.S. annual capacity					Canadian annual capacity
	Recycled paperboard grades					Total boxboard
Year	U.S. total	Paperboard[1]	Folding and setup	Gypsum liner	Other[2]	including bleached board
1990e	10,029	2,791	2,939	1,405	2,894	912
1989e	9,612	2,531	2,859	1,405	2,816	798
1988	9,532	2,476	2,889	1,411	2,756	767
1987	9,268	2,240	2,936	1,386	2,706	773
1986	9,008	2,089	2,934	1,349	2,637	775
1985	8,795	1,998	2,929	1,265	2,603	798
1984	8,722	2,145	2,922	1,249	2,405	798
1983	8,692	2,068	2,995	1,217	2,412	767
1982	8,690	2,130	3,007	1,255	2,298	758
1981	8,600	2,121	2,968	1,251	2,260	792
1980	8,617	2,122	2,942	1,238	2,313	807
1979	8,757	2,111	3,019	1,273	2,355	861
1978	8,642	2,015	2,986	1,238	2,403	851
1977	8,699	2,132	3,117	1,112	2,337	796
1976	8,774	2,235	3,155	1,046	2,337	747
1975	8,717	2,221	3,123	1,063	2,310	744
1974	8,680	2,132	3,170	1,100	2,278	714
1973	8,330	1,833	3,182	1,093	2,221	681
1972	8,185	1,785	3,109	1,082	2,209	659
1971	8,078	1,652	3,292	1,031	2,104	—
1970	8,084	1,697	3,381	1,013	1,993	—

e = Estimate.

1. Includes linerboard, corrugating medium, and container chip and filler board.

2. Others include tube, can, and drum stock, special packaging boards, and panel and wallboard stocks.

Sources: American Paper Institute, Canadian Pulp & Paper Assn.

mold rotates opposite to the stock flow (counterflow vat). Stock is formed on a wire-covered cylinder mold by pressure differential inside and outside the cylinder mold. The sheet, or ply, is couched off the top of the cylinder by a felt and ply. Counterflow systems produce a sheet with a high MD fiber orientation. As speed increases, sheet formation becomes poorer; with significant variations in the sheet, weight pickup decreases.

Sheet formation can be improved somewhat by using a direct vat where cylinder mold rotation is in the same direction as stock flow. Any additional improvement in formation can be achieved by using a dry vat. The dry-vat principle, also called "half-vat," was developed by the Boxboard Research & Development Assn. Conventional cylinder formers can be upgraded in several ways. The easiest, least expensive method is to add new slice or headbox designs (pressure formers) to existing cylinder machines. This results in better control over grain ratios and improved dewatering. However, such units have limited speed and rarely exceed 600 fpm. Units such as the Beloit Corp.'s Stevens Former and Sandy Hill Corp.'s Rotoformer use vacuum suction to increase dewatering.

In the late 1960s, Kobayashi Engineering Works Ltd. introduced its first former, the Ultra Former. This series became known as cylinder-on-top formers, wherein the sheet is formed and dewatered on top of a cylinder mold or drilled shell, then it travels downward from the slice to be transferred to the top of a carrier felt of fabric.

The Kobayashi former was designed to replace individual vats on cylinder machines. The Ultra Former permits the felt pickup to wrap the cylinder mold, thus eliminating drop-off, a problem common to conventional cylinder vat machines. The Ultra Former also produces a somewhat lower-density sheet than is possible with conventional cylinder machines.

Another new former, the on-top cylinder former with dewatering wires, is designed to be used with fourdrinier formers, but it can sometimes be used in place of a conventional cylinder vat.

Multi-ply boards can also be produced on modified fourdrinier machines in two ways: small fourdriniers are positioned on top of a long fourdrinier section, or on-top formers are positioned on top of a fourdrinier section. Beloit has a different approach for making lightweight multi-ply on a fourdrinier. It uses a headbox (Strata-Flo/Converflo) that can simultaneously deliver a two- or three-ply sheet to either a fourdrinier wire or a twin-wire former.

Twin-wire formers made an early debut into multi-ply forming, but they were used only on a limited basis until the 1970s. The first twin-wire former was jointly developed by St. Anne's Board Mill Co. in the U.K. and Walmsley Ltd. (Beloit). It was called the Inverform, and it became the forerunner of all twin-wire formers. Inverform units were placed over a conventional fourdrinier table, and considerable dewatering was achieved through the top wire via drainage in an upward direction.

By the 1970s, several machine manufacturers had developed their own versions of twin-wire formers. Based on its experience with the Inverform, Beloit developed its Bel Bond former, which has better dewatering and speed charac-

ESTIMATED CAPACITIES FOR RECYCLED BOXBOARD/ PAPERBOARD OF MAJOR U.S. COMPANIES

	Company	Annual capacity (000 short tons)	Grades*
1.	Jefferson Smurfit[1]	1,330	CB, BB, CM, LB, CS, TS, SP
2.	Newark Group[2]	875	CB, BB, CM, PB, TS, SP, GL
3.	Sonoco Products[3]	850	PB, CS, DS, TS, SP
4.	Caraustar Industries[4]	550	BB, GL, PB, CS, TS, SP
5.	Rock-Tenn[5]	532	CB, BB, GL, CS, SP, PB, TS
6.	Inland Container[6]	475	CM, LB
7.	Waldorf[7]	395	BB, CS, DS, TS, CB, CM
8.	U.S. Gypsum	332	GL
9.	Virginia Fibre	260	CM
10.	Georgia-Pacific	235	GL
11.	National Gypsum	215	GL, PB, CB, BB, CS, TS, SP
12.	Packaging Corp. of America[8]	210	CB, BB, PB, CM, LB, GL
13.	Federal Paper Board[9]	175	CB
14.	James River	175	CB, BB, CM, LB
15.	Simkins Industries[10]	160	CB, BB, SP
16.	Republic Gypsum	135	BB, CS, GL, SP, TS, CM

* = Code: BB-uncoated boxboard; CB-coated boxboard; CM-corrugating medium; CS-core stock; DS-drum stock; GL-gypsum liner; LB-linerboard; PB-unspecified paperboards; SP-specialty paperboards; TS-tube stock.

1. Reflects combined operations with Container Corp. of America.
2. Bought Lawrence Packaging Corp.'s Lawrence, Mass., mill in 1985; Federal Paper Board Co.'s Los Angeles, Calif., mill in 1988; and National Gypsum's Stockton, Calif., mill in 1989.
3. Bought Federal Paper Board Co.'s Richmond, Va., mill in 1988.
4. Bought CCA's mills at Chattanooga, Tenn.; Cincinnati, Ohio; and Chicago, Ill., in 1984. Bought U.S. Gypsum's Camden, N.J., mill in 1988.
5. Bought Stroudsburg Paperboard Corp.'s mill in 1984. Bought Mead Corp.'s mills at Lynchburg, Va.; Cincinnati, Ohio; and Otsego, Mich., in 1987.
6. Subsidiary of Temple-Inland Inc. Started up new 175,000-tpy test linerboard mill in Ontario, Calif., in late 1985.
7. Company formed to buy former St. Regis Corp. boxboard mills at St. Paul, Minn., and Battle Creek, Mich., from Champion International Corp. in 1985.
8. In 1983, sold two chipboard mills to Republic Gypsum Corp. and a clay-coated mill in Stroudsburg, Pa. (later sold to Rock-Tenn Co.).
9. Sold Richmond, Va., and Los Angeles, Calif., mills in 1988.
10. Bought Lowe Paper Co. in 1984.

ANNUAL U.S. CAPACITY FOR RECYCLED FOLDING AND SETUP BOXBOARDS

(000 short tons)

Year	Folding	Setup
1990e	2,634	305
1989e	2,558	301
1988	2,601	288
1987	2,661	275
1986	2,662	272
1985	2,640	289
1984	2,626	296
1983	2,681	362
1982	2,676	352
1981	2,638	321
1980	2,593	349
1978	2,568	418
1976	2,705	450
1974	2,665	505
1972	2,607	502
1970	2,805	576
1969	3,029	577

e = Estimate.
Source: American Paper Institute.

U.S. EXPORTS AND IMPORTS OF RECYCLED PAPERBOARD[1]

(000 short tons)

Year	Exports	Imports
1989	185	85
1988	283	86
1987	329	81
1986	199	78
1985	246	68
1984	169	69
1983	150	50
1982	158	31
1981	174	40
1980	249	57
1979	176	42
1978	203	47
1977	268	28
1976	306	13
1975	262	8
1974	283	34
1973	207	33
1972	163	8
1971	168	17
1970	151	10
1969	143	11

1. Bureau of the Census data for total recycled-furnish paperboard, including test containerboard and other paperboard.

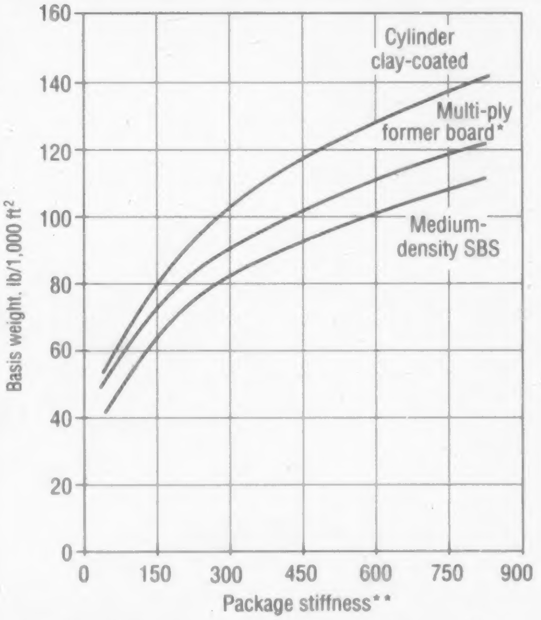
teristics and, like the Inverform, can be positioned over a fourdrinier wire to form a multi-ply board.

Kobayashi's Ultra Former, introduced in 1975, combines flat-forming and centrifugal water removal with a second fabric wire, but the sheet is formed before the twin forming fabrics meet. The sheet is transferred to a felt, where it is plied to the preceding layer carried by the felt.

In 1988, Black Clawson Co. introduced its Bristol Former MK II pressure former and projection slice headbox, an improved design developed in collaboration with BRDA/St. Anne's Board Mill Co. The Bristol Former can be fitted to existing equipment and can be installed with a suction roll or as a top-wire former to produce a wide range of multi-ply paperboard grades.

COMPARISON OF PACKAGE STIFFNESS FOR GIVEN FIBER WEIGHT

(SBS board produced on fourdrinier machines, recycled fiber board made on conventional cylinder and on multi-ply formers)

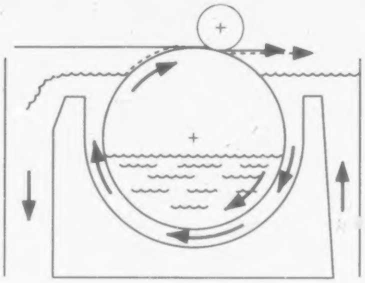


*Assumes basic board density at 3.5 lb/point/1,000 ft^2 coating weight at 8 lb/1,000 ft^2.
**Package stiffness = (MD stiffness)$^{0.33}$ x (CMD stiffness)$^{0.667}$
Source: Fibreboard Corp. and Arthur D. Little Inc.

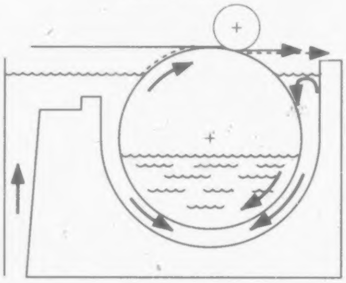
Source: *Pulp & Paper*, December 1978.

COUNTERFLOW VAT VS DIRECT-FLOW VAT

Direct-flow vat



Counterflow vat



Source: *Pulp & Paper*, December 1978.

ESTIMATED CAPACITIES FOR RECYCLED BOXBOARD/PAPERBOARD OF CANADIAN COMPANIES

Company	Annual capacity (000 short tons)	Grades*
Paperboard Industries[1]	550	CB, PB, CM, LB, GL, CS
Atlantic Packaging	140	CM, LB
Beaver Wood Fibre[2]	122	BB, PB, TS, GL
Kruger	103	LB, CS, TS
Domtar	90	LB, CM
Sonoco Products	77	PB, CS, TS
Strathcona Paper	61	BB, PB, SB, CB
Minas Basin Pulp & Paper	35	BB, PB, CS, LB, TS, PB
Others	135	

*Code: BB—uncoated boxboard; CB—coated boxboard; CM—corrugating medium; CS—core stock; DS—drum stock; GL—gypsum liner; LB-linerboard; PB—unspecified paperboard; SP—specialty paperboard; TS—tube stock.

1. Bought Belkin Inc. in 1987.
2. Subsidiary of Georgia-Pacific Corp.

Fiber:

PULPING PROCESSES

Before paper can be made, papermakers must be furnished with a supply of fibers capable of producing a paper or board grade with desired strength properties and good runability on paper machines. The primary sources of fiber for papermaking are 1) pulpwood, 2) wastepaper, 3) nonwood fibers, and 4) inorganic fibers. In the U.S., about 1% of the fiber supplied for paper and board making is from nonwood and inorganic sources such as asbestos or bagasse. About 72% of the fiber supply is derived from pulpwood and 27% from wastepaper.

Pulping is the chemical or mechanical process of freeing fibers from wood. The goal of pulping is to disintegrate or separate woodfiber into its individual fibers without reducing fiber lengths or damaging strength properties. Pulping is accomplished in two ways: by mechanical or chemical forces, or a combination of the two. There are many different mechanical and chemical processes for pulping (or cooking) pulpwood. Choice of pulping process depends mainly on the grade of pulp necessary to meet the strength requirements of a specific paper or board grade.

In mechanical pulping, mechanical energy from grinding or attrition is used to separate the fibers from one another. In chemical processes, strong chemicals and high temperatures are used to dissolve the binding material between fibers, and once these binding materials (lignins) are partially removed or dissolved, the fibers will separate with a minimum of mechanical action, referred to as refining.

PULPWOOD SUPPLY

Choice of pulpwood species depends on the mill's location and the paper or board grades it produces. In the U.S. South, the principal species used are southern pine, mixed hardwood, and oak. In the Pacific Northwest, the major species are Douglas fir, hemlock, western pine, and small amounts of western cedar, redwood, and spruce. In the U.S. Midwest, the species most often used are mixed hardwoods, oak, and spruce. In the U.S. and Canadian Northeast, the major species are eastern spruce, pine, balsam fir, and mixed hardwood (poplar, white birch).

Because of increasing pressure on available softwood timber supplies, the percentage of hardwood used for pulp production is expected to rise gradually. Hardwoods comprise about 40% of the commercial timber supply in the U.S. and about 21% of total timber volume in Canada. In the U.S., hardwoods have grown from only 10% of total pulp production in the mid-1940s to about 30% currently.

In Canada, however, hardwoods have accounted for only 10% of the pulp produced in recent years—a situation that partly reflects the Canadian industry's concentration on bleached softwood kraft pulp and newsprint. Hardwood use in Canada is expected to grow because of increased printing/writing paper production and because of market pulp expansion projects based on hardwood in Alberta.

Pulpwood is delivered to the pulp mill in either chips or logs. In the U.S. Pacific Northwest, about 65% to 70% of the pulpwood used is sawmill residue. The concept of getting the most value from a tree—first using logs for lumber or plywood and then using the residuals from the sawmills for energy or pulpwood—has been practiced in the Northwest since the 1920s. This approach is increasingly finding acceptance in the U.S. South, where rotation cycles are being extended to yield more timber that can be processed into higher-value lumber and plywood. Within the next decade, as much as 50% of the pulpwood delivered to southern mills will be in the form of byproduct woodchips—up from about 30% currently. In the Northeast, both in Canada and the U.S., most of the pulpwood delivered to mills is in roundwood form; however, even in this area, the trend is toward using more sawmill chips.

A major drawback to the heavy use of residuals is that availability and cost of chips become tied to the housing cycle, which tends to be countercyclical to the pulp industry. The housing downturn in 1980 choked off the flow of byproduct residuals from Pacific Northwest sawmills at a time when pulp production was strong, and this triggered a sharp rise in chip costs. More recently, chip prices in the region have risen sharply due to environmental pressures to restrict harvesting of old-growth timber. As a result, pulp and paper mills in the region are trying to chip more low-value logs and use more wastepaper.

PULPING PROCESSES

North American pulp mills use five major pulping processes: 1) sulfate (kraft), 2) sulfite, 3) semichemical, 4) mechanical, and 5) defibrated. Each process produces a different quality and yield of pulp from wood. The mechanical and defibrated processes produce low-quality pulp (i.e., low in strength but high in yield). Semichemical pulp, which is produced mainly from hardwood, is an intermediate-quality pulp with medium levels of yield—60% to 80%. Chemical pulps have the highest quality of pulp, but their yields are the lowest—45% to 55%.

Major modifications exist within each pulping group. For example, sulfate pulping generates high-yield and low-yield pulps. Mechanical pulping features at least five modified processes, plus two minor chemical pulping processes: the soda process and the prehydrolyzed sulfate process. The soda process has a soda cook, and it uses either sodium hydroxide or soda ash to produce a medium-quality chemical pulp from hardwood species. The prehydrolyzed sulfate process produces a dissolving pulp (chemical cellulose) from either hardwoods or softwoods, and these are used to produce rayon, acetate, cellophane, or chemical cellulose.

BLEACHING PROCESS

After the pulping process, woodpulp still contains some lignin and must be bleached to improve brightness. Bleaching is accomplished by either removing the lignin (delignification) or decolorizing it with oxidizing or reducing chemicals. Major oxidizing chemicals are chlorine (C), sodium hypochlorite (H), chlorine dioxide (D), and hydrogen peroxide (P). Sodium hydrosulfite is a reductant. Alkali, usually sodium hydroxide or caustic soda (E), is used to extract solubilized lignin from the cellulose.

Brightness is measured optically by test instruments that indicate brightness points (GE, ISO, or Elrepho units used respectively in the U.S., Canada, and rest of the world).

U.S. WOODPULP PRODUCTION

(000 metric tons)

Year	Total all grades	Special alpha/ dissolving	Bleached sulfite	Un-bleached sulfite	Bleached and semibleached sulfate and soda*		Un-bleached sulfate	Semi-chemical	Ground-wood and thermo-mechanical
					Softwood	Hardwood			
1989	56,224	1,293	1,244	173	12,428	12,021	19,638	3,958	5,469
1988	55,485	1,240	1,238	175	12,110	11,752	19,624	3,952	5,391
1987	54,024	1,190	1,151	155	11,807	11,246	19,451	3,852	5,173
1986	51,725	1,141	1,157	149	11,349	10,567	18,448	3,802	4,978
1985	49,121	1,065	1,238	178	11,001	9,525	17,700	3,653	4,763
1984	50,323	1,094	1,233	235	10,934	9,342	18,798	3,691	4,995
1983	47,586	1,144	1,186	281	10,377	8,772	17,772	3,458	4,597
1982	44,755	991	1,127	313	10,189	7,702	16,484	3,356	4,594
1981	47,212	1,227	1,273	362	10,552	7,656	17,757	3,560	4,826
1980	46,027	1,369	1,324	349	9,867	7,369	17,773	3,652	4,324
1979	44,781	1,360	1,250	358	9,359	7,024	17,762	3,681	3,985
1978	43,032	1,277	1,286	298	9,022	6,494	17,247	3,657	3,750
1977	42,319	1,329	1,499	353	9,016	5,909	16,697	3,516	3,999
1976	41,187	1,348	1,587	380	8,476	5,833	16,171	3,478	3,911
1975	36,838	1,241	1,505	332	6,457	5,114	13,814	3,102	4,003
1974	40,676	1,607	1,736	354	6,960	5,812	15,407	3,437	4,074
1973	41,084	1,517	1,742	338	6,646	5,479	15,955	3,531	4,393
1972	39,544	1,521	1,629	302	6,247	5,103	15,668	3,443	4,180
1971	37,211	1,528	1,503	334	5,915	4,616	14,373	3,256	4,279
1970	37,050	1,557	1,733	361	5,683	4,803	14,206	3,091	4,066
1965	28,855	1,348	2,077	454	3,961	2,822	10,695	2,606	3,540
1960	21,755	1,032	1,855	483	3,754	1,191	7,878	1,807	2,959
1955	17,570	892	1,732	586	2,659	646	6,962	1,264	2,450
1950	12,447	434	1,478	672	2,100		5,179	611	1,973

*Bureau of the Census data show that semibleached sulfate production declined from 1.729 million metric tons in 1970 to 1.078 million tons in 1980—the last year production was broken out; soda pulp production was last shown by Census at 181,000 tons in 1974.

Source: American Paper Institute.

Chemical pulp is bleached in large, multistage bleaching processes by sequential chemical and washing treatment. Choice of bleaching sequence depends on pulp type, chemical costs, capital costs, and environmental considerations. For kraft pulp, a typical bleaching sequence might be chlorine, caustic (alkali extraction), chlorine dioxide, caustic (alkali extraction), and chlorine dioxide (commonly represented as the CEDED process). Chlorine for many years was the major chemical used in the first stage of the bleaching process because of its low cost and effectiveness. Other common bleaching stages are peroxide (P) or hypochlorite (H). Additional chemicals may be added during each stage to make the bleach plant more efficient. For example, oxidative extraction is becoming more popular. Oxygen is mixed with pulp before the first extraction stage in order to reduce bleaching chemicals further downstream in the bleach line. Fully bleached chemical pulps have brightnesses in the 85 to 90 GE range. Semibleached pulps average 70 to 80 GE.

Reductive bleaching is used to brighten groundwood and deinked pulps. Some oxidating agents such as peroxides, chlorine, and hypochlorites are also used. These brighten pulps to only 55 to 65 GE, and often it is done in one stage of bleaching. Some producers use multistage bleach lines to achieve higher brightness—in the 80-to-82 range for new bleached chemi-thermomechanical softwood pulp mills using peroxide bleaching.

SULFATE OR KRAFT PROCESS

The sulfate or kraft process is the most widely used process for wood pulping. Since 1950, sulfate pulping has grown from 38% to 67% of North American capacity. About 170 kraft mills are located in the U.S. and Canada, with a combined capacity in 1989 of 56.3 million metric tons. Of this amount, U.S. mills accounted for 44.8 million tons and Canadian mills accounted for 11.5 million tons.

In this alkaline process, woodchips are cooked under high pressures and temperatures in a "white liquor" solution of sodium hydroxide and sodium sulfide. The chips are pulped in large pressure digesters by either batch or continuous processes for one to two hours at temperatures exceeding 170°C (338°F). Depending on the quality of pulp desired, the amount of alkali, length of cooking time, and degree of temperature are varied to produce pulps of high or low yield. The higher-yield pulps have a higher lignin content, and they are typically used for linerboard and the coarser grades of kraft papers. If a pulp is to be bleached, the kraft pulping stage employs stronger conditions to reduce the pulp's lignin content. Because softwood pulps have more lignin than hardwood pulps, additional chemical is required to cook the pulp to a particular lignin content.

The kraft process is very versatile. It produces good-quality pulps from nearly all hardwood and softwood species, its chemicals can be recovered economically in a straightforward recovery process, the technology is well understood, and it produces a strong, easily bleached fiber. The kraft process is also attractive from an economic standpoint because its waste material, called black liquor, can readily be washed from the pulp, concentrated, and burned for recovery of energy and chemicals. A well-designed linerboard mill can be 50% or more self-sufficient in energy by burning waste liquors.

The kraft process does have certain deficiencies: 1) capital requirements for constructing kraft pulp mills are extremely high (over $500,000/annual ton), and mills must be built with special metals because the liquors from this process are very corrosive; 2) odor pollution, principally from the sulfur compounds emitted during pulping and recovery, is a serious problem, although most odor emissions can be controlled with modern pollution-abatement procedures; 3) pulp yield is rather low (45% to 55%); 4) explosions caused by molten smelt coming into contact with water are a safety hazard; 5) dioxins (in very low levels) are present in the discharge of bleached kraft pulp mills.

As previously noted, chlorine is used in the bleaching

U.S. PULPWOOD CONSUMPTION BY PULPING PROCESS

(000 cords or 128 ft^3)

	1989	1988	1987	1986	1985	1984	1983	1980	1970
All processes, total	96,067	95,264	92,386	90,554	84,840	86,948	83,493	79,703	67,562
Dissolving/special alpha	n.a.	3,492	3,014	2,866	2,551	2,544	2,776	3,378	3,673
Sulfite	3,124	3,174	2,915	n.a.	n.a.	n.a.	n.a.	3,494	5,016
Sulfate, total	78,130	77,163	75,085	72,175	66,536	68,611	65,322	62,408	49,366
Bleached and semibleached	42,015	41,247	39,600	36,671	33,340	33,968	32,427	30,110	22,327
Unbleached	36,115	36,108	35,485	35,503	33,832	34,643	32,895	32,299	27,039
Groundwood[1]	n.a.	5,880	5,624	5,513	5,337	5,508	5,142	4,483	4,234
Semichemical	3,999	4,107	4,061	4,081	3,851	3,912	3,798	3,853	3,456
Defibrated or exploded	1,568	1,520	1,687	n.a.	n.a.	n.a.	n.a.	2,087	1,818

n.a. = Not available.

1. Includes chemigroundwood.

Source: Bureau of the Census.

TABULATION OF NORTH AMERICAN PULP AND PAPER MILLS

	Companies[1]	Establishments	Paper mills[2]	Total pulp mills	Groundwood	Other mechanical[3]	Semichemical	Sulfite	Kraft	Miscellaneous[4]
Alabama	19	20	18	21	3	1	2	—	13	2
Alaska	2	2	—	2	—	—	—	2	—	—
Arizona	2	2	2	5	2	—	—	—	1	2
Arkansas	9	10	9	9	1	1	—	—	7	—
California	33	42	33	13	—	3	1	—	4	5
Colorado	2	2	1	—	—	—	—	—	—	—
Connecticut	19	20	10	1	—	—	—	—	—	1
Delaware	3	5	3	1	—	—	—	—	—	1
Florida	15	15	10	10	—	—	—	1	8	1
Georgia	32	32	21	20	3	1	1	—	12	3
Idaho	2	3	2	1	—	—	—	—	1	—
Illinois	17	19	11	2	—	—	—	—	—	2
Indiana	13	16	13	2	—	—	1	—	—	1
Iowa	2	2	1	1	—	—	1	—	—	—
Kansas	2	2	2	—	—	—	—	—	—	—
Kentucky	5	7	5	3	—	—	1	—	2	—
Louisiana	11	16	13	19	3	1	4	—	10	1
Maine	19	24	20	21	11	—	—	1	7	2
Maryland	5	5	4	2	1	—	—	—	1	—
Massachusetts	34	47	38	5	—	—	—	—	—	4
Michigan	37	41	36	11	2	1	3	—	3	2
Minnesota	12	14	12	11	6	3	—	—	2	—
Mississippi	13	15	11	9	2	2	—	—	5	—
Missouri	6	6	4	1	—	1	—	—	—	—
Montana	1	1	1	1	—	—	—	—	1	—
New Hampshire	18	20	14	2	—	—	1	—	1	—
New Jersey	25	32	17	3	—	—	—	—	—	3
New Mexico	1	1	1	—	—	—	—	—	—	—
New York	54	68	53	14	3	3	—	1	1	6
North Carolina	19	22	18	13	1	3	1	—	5	3
Ohio	35	41	32	11	—	3	2	—	1	5
Oklahoma	6	7	7	6	—	1	1	—	1	3
Oregon	15	23	17	21	6	3	3	—	7	2
Pennsylvania	43	48	36	8	—	1	2	1	3	1
Puerto Rico	1	1	—	—	—	—	—	—	—	—
South Carolina	13	13	12	11	3	1	2	—	6	—
Tennessee	18	19	13	11	2	1	2	—	2	4
Texas	15	17	12	10	3	1	—	—	6	—
Vermont	7	8	7	2	1	—	—	—	—	1
Virginia	20	21	14	10	2	1	3	—	4	—
Washington	19	28	19	24	6	1	3	6	7	1
West Virginia	2	2	2	—	—	—	—	—	—	—
Wisconsin	44	59	49	34	7	4	2	6	4	11
TOTAL U.S.	394	798	603	351	68	37	36	18	125	67
Alberta	7	9	4	6	2	1	—	—	3	—
British Columbia	25	39	13	34	14	1	—	1	18	—
Manitoba	5	5	4	5	2	1	—	1	1	—
New Brunswick	10	11	7	14	6	1	2	2	3	—
Newfoundland	2	3	3	5	3	—	—	2	—	—
Nova Scotia	5	5	4	6	3	—	—	2	1	—
Ontario	24	49	34	36	14	3	2	4	9	4
Quebec	46	79	55	68	33	8	2	9	10	6
Saskatchewan	2	2	2	1	—	—	—	—	1	—
TOTAL CANADA	101	202	126	175	77	15	6	21	46	10

1. Subsidiaries and autonomous divisions of parent companies are counted as separate units. Totals of this column reflect elimination of duplication of names in more than one state or province.
2. Includes mills manufacturing paper and/or paperboard, regardless of the number of paper machines, and regardless of whether or not one or more pulp mills are located at the site.
3. Includes steam and hot water defibrated, exploded, shredded, cold soda, and chemimechanical woodpulp mills.
4. Includes deinking, rag, soda, rope, flax, bagasse, and cotton linters pulp mills.

Source: *1990 Lockwood-Post's Directory.*

process of virtually all kraft pulp mills, and it is the chemical primarily responsible for the formation of chlorinated organic compounds such as dioxins and furans. (See chapters on U.S. and Canadian environmental spending and regulations.) Many new developments in process technology are aimed at reducing the use of chlorine in pulp bleaching; however, the chemical cannot be totally eliminated without a loss in pulp quality. One approach to chlorine reduction is the maximum removal of lignin before pulp enters the bleach plant. This technique can be broadly described as extended delignification, and it includes the Kamyr process of modified continuous cooking (MCC) in continuous digesters, Beloit's rapid displacement heating in batch digesters (RDH), and various types of oxygen delignification.

Oxygen delignification. This process was developed in the late 1960s and early 1970s in Scandinavia. It involves an oxygen reactor vessel located after brownstock washing and before the bleaching sequence. Because pulp entering the bleach plant has lower lignin content, chlorine usage is decreased and the bleach plant effluent contains less chlorinated organic compounds as well as BOD and color. Oxygen delignification was first developed as a high-consistency process; most new systems are medium consistency because of lower capital costs and better efficiency.

Over 50 oxygen delignification systems have been installed worldwide, of which about half are located in Scandinavia and Europe. About eight systems have been installed in North America, and over a dozen more have been announced for new or existing mills. One problem with retrofitting an existing mill with oxygen delignification is the increased load (4% to 5%) on the chemical recovery system. As a result, oxygen delignification may not be attractive to an existing mill that is fully utilizing its recovery system because the mill would have to install additional boilers and evaporators. Another way to reduce chlorine usage is through improved brownstock washing, which reduces carryover of dissolved organic solids into the bleach plant. Also effective is the replacement of chlorine with chlorine dioxide in the chlorination stage of bleaching.

U.S. WOODPULP CAPACITY TRENDS

(000 short tons)

Year	Total all grades	Dissolving and special alpha	Total sulfite[1]	Bleached* softwood sulfate[2]	Bleached* hardwood sulfate[2]	Unbleached sulfate	Semi-chemical[3]	Mechanical	Screenings
1992e	69,896	1,495	1,622	15,964	14,538	23,880	4,967	7,426	4
1991e	68,336	1,495	1,622	15,246	13,953	23,671	4,964	7,363	4
1990e	66,048	1,495	1,622	14,674	13,202	23,020	4,925	7,105	4
1989	64,288	1,495	1,619	14,347	12,844	22,481	4,865	6,632	4
1988	62,950	1,450	1,627	14,056	12,450	22,145	4,787	6,432	4
1987	61,172	1,389	1,646	13,623	11,823	21,733	4,697	2,942	6
1986	59,750	1,399	1,703	13,169	11,402	21,381	4,631	6,058	7
1985	58,641	1,454	1,738	12,874	10,750	21,182	4,650	5,964	29
1984	59,001	1,487	1,750	12,490	9,867	21,372	4,652	6,122	29
1983	57,590	1,525	1,788	12,111	9,179	21,206	4,490	5,814	31
1982	57,638	1,606	1,780	12,052	8,705	21,435	4,734	5,780	34
1981	56,831	1,598	1,855	11,757	8,559	20,972	4,597	7,434	58
1980	55,214	1,590	1,909	11,339	8,356	20,288	4,601	7,069	61
1979	53,636	1,551	2,004	10,897	8,078	19,923	4,553	6,572	63
1978	52,714	1,573	2,095	10,442	7,729	19,732	4,572	6,507	65
1977	51,849	1,648	2,525	10,048	7,322	19,552	4,514	6,442	71
1976	50,547	1,571	2,417	9,355	7,227	19,293	4,402	6,204	78
1975	49,502	1,671	2,420	9,025	7,208	18,758	4,246	6,090	84
1974	48,995	1,824	2,401	8,923	7,138	18,451	4,233	5,930	97
1973	48,459	1,754	2,378	8,842	6,936	18,475	4,171	5,802	100
1972	46,760	1,756	2,353	8,971	6,093	17,702	3,937	5,813	137
1971	45,731	1,772	2,414	8,266	6,008	17,091	3,814	4,680	156
1970	44,725	1,736	2,490	7,798	5,781	16,811	3,811	4,799	154

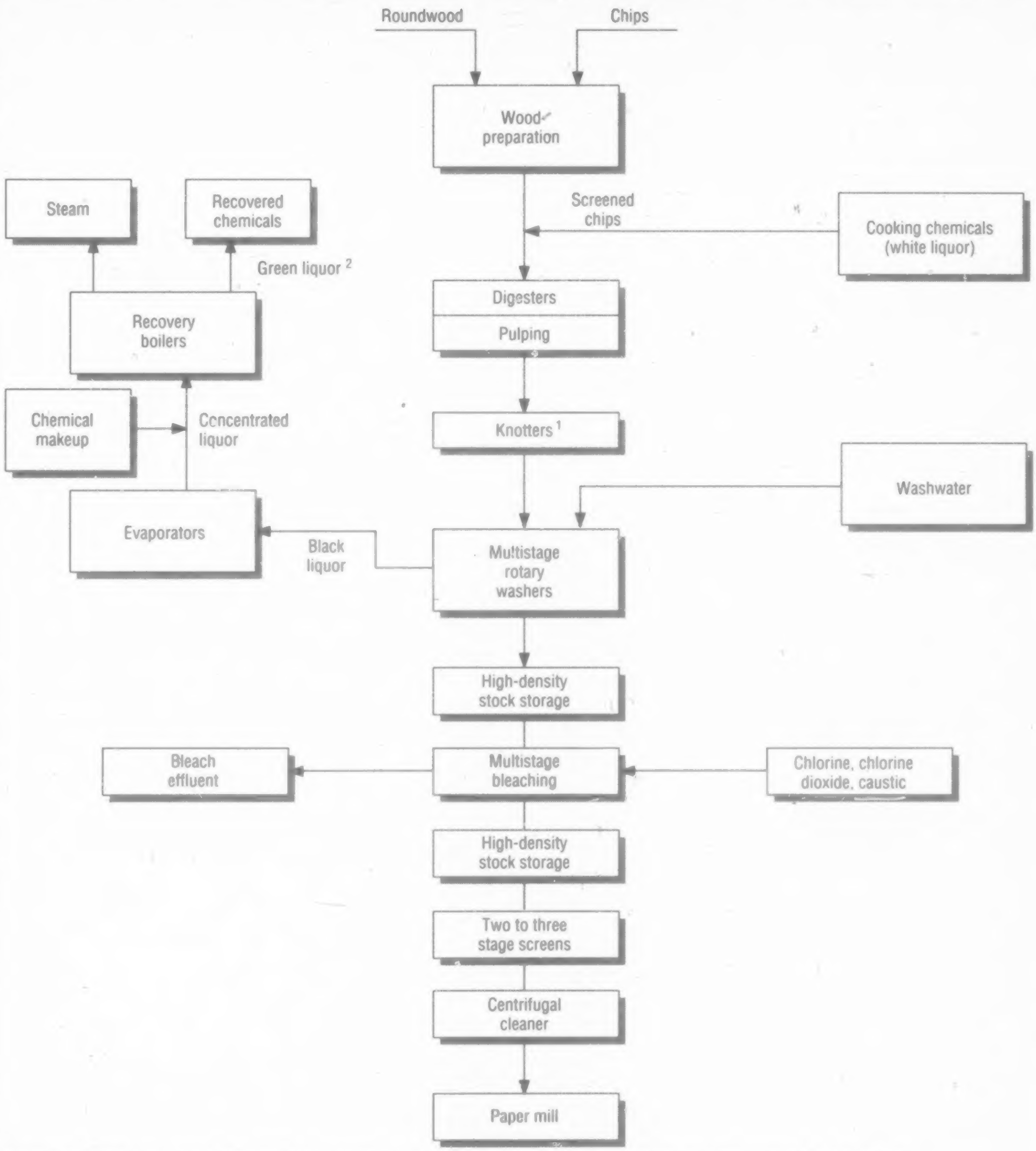
*Includes soda pulp.

e = Estimate.

1. Mainly bleached; unbleached sulfite capacity in 1983 was 400,000 tons.
2. Includes semibleached (1.5 million tons in 1977, the last year for which data were available).
3. Bleached semichemical capacity in 1983 was 361,000 tons.

Source: American Paper Institute.

SIMPLIFIED PROCESS FLOWS FOR KRAFT PULPING


Roundwood
Chips
Wood preparation
Screened chips
Cooking chemicals (white liquor)
Digesters
Pulping
Knotters [1]
Washwater
Multistage rotary washers
Black liquor
Evaporators
Concentrated liquor
Chemical makeup
Recovery boilers
Steam
Recovered chemicals
Green liquor [2]
High-density stock storage
Multistage bleaching
Bleach effluent
Chlorine, chlorine dioxide, caustic
High-density stock storage
Two to three stage screens
Centrifugal cleaner
Paper mill

1. Some kraft mills use a hot stock refining before washing. These systems use a refiner to defibrate the unbleached pulp after pulping. The defibrated pulp is then screened before washing.
2. Green liquor from recovery is treated in the causticizing process to process white liquor.

SULFITE PROCESS

Acid sulfite pulping is the oldest chemical pulping process used in North America, but its use has been declining. While U.S. and Canadian kraft pulp capacity more than quadrupled from 1950 to 1987, sulfite capacity remained almost flat during this period. In 1989, production at 45 mills totaled 3.25 million metric tons. Of this amount, about 1.4 million tons were produced in the U.S. and 1.8 million tons were produced in Canada.

The sulfite process uses a solution of sulfurous acid and bisulfite salts at high temperatures to dissolve the binding lignins holding fibers together. Pulping is done in large batch digesters for six to nine hours, depending on pulp quality. A wide range of yields can be produced by the sulfite process. High-yield sulfite (typically called bisulfite pulp) is used for newsprint and has yields of about 55%. Chemical-grade acid sulfite pulp has much lower yields in the range of 45%.

Several different chemical bases are used to produce sulfite pulps. Originally, the sulfite pulping process used a calcium base; however, recovery of spent liquors was difficult and uneconomical. Today, sulfite processes are based not only on calcium but also on ammonia, sodium, and magnesium. The sodium- and magnesium-based processes offer full chemical recovery. In the ammonia-based process, liquor is burned for energy, but its ammonia or nitrogen values are not necessarily recovered. However, sulfur dioxide from this process can be recovered.

Chemical-grade sulfite pulps are used to make fine papers, tissue papers, bristols, and other high-quality papers. But sulfite pulps produced from either softwoods or hardwoods have poorer strength properties than equivalent sulfate pulps. This has prevented their use in areas where high strength is required (e.g., linerboard, bag and sack).

SEMICHEMICAL PULPING

Semichemical pulping was developed in the late 1920s at the Forest Products Research Laboratory in Madison, Wis. It was intended for the pulping of hardwoods, which at that time were not extensively used for pulp fiber. The process involves a mild chemical pulping of chips prior to mechanical defibrating. Semichemical pulp has an intermediate strength level and a fairly high yield—60% to 80%. Although the process is used mainly for pulping hardwood chips, it can also handle softwood chips and sawdust. Semichemical pulping of hardwood fibers provides an excellent pulp for corrugating medium.

The original semichemical process is called neutral sulfite semichemical process (NSSC). It pulps hardwood chips in a solution of sodium sulfite at an alkaline pH. Soda ash

U.S. CONSUMPTION OF FIBROUS MATERIALS IN PULP, PAPER, AND BOARD MANUFACTURE[1]

(000 short tons)

			Wastepaper						
Year	Total woodpulp[1]	Total wastepaper[2]	Mixed	News	Corrugated	High-grade pulp substitutes	High-grade deinking	Other[3]	Cotton linter pulp
1989	62,701	17,964	2,424	3,421	8,993	1,310	1,816	254	120
1988	62,764	17,537	2,546	3,234	8,748	1,324	1,684	275	139
1987	61,231	16,618	2,169	3,143	8,345	1,433	1,529	273	105
1986	59,882	15,419	2,115	3,140	7,502	1,253	1,409	288	111
1985	56,639	14,818	2,081	3,031	7,234	1,111	1,360	301	95
1984	50,309	14,944	2,136	3,018	7,231	1,248	1,310	346	92
1983	53,970	14,170	2,059	2,783	6,846	1,262	1,220	334	79
1982	50,186	13,563	1,980	2,790	6,486	1,237	1,148	331	65
1981	52,779	12,872	2,165	2,417	5,919	1,380	991	451	58
1980	51,804	12,583	2,686	2,116	5,628	1,302	851	556	49
1979	51,557	13,012	2,889	2,131	5,737	1,401	854	681	47
1978	49,694	12,481	3,149	3,149	5,187	1,338	786	779	46
1977	49,132	12,103	3,001	3,001	4,839	1,403	784	785	40
1976	47,541	11,874	3,009	3,009	4,618	1,323	771	700	42
1975	42,431	10,367	2,761	2,761	3,950	1,142	650	587	37
1974	48,341	12,098	3,332	3,332	4,669	1,427	615	792	37
1970	43,192	10,594	3,393	3,140	3,511	1,377	493	780	46

1. Woodpulp is also consumed in many nonpaper and board products, such as chemical cellulose, molded pulp products, etc.
2. Census data for wastepaper consumption are lower than those reported by American Paper Institute. See section on wastepaper.
3. Straw, rags, bagasse, etc.
Source: Bureau of the Census.

is added to buffer the acids formed during pulping. When NSSC pulping was first practiced, it was done in rotary digesters using batch techniques. With the development of digesters such as the Pandia, M&D, and Defibrator, most NSSC pulp mills adopted continuous pulping. Digesting retention time is very short in continuous pulping, typically not over 30 min at temperatures exceeding 170°C (338°F). The spent chemicals and organic materials are either washed or pressed from the pulp, then burned in a fluidized-bed incinerator or in specially designed units such as Tampella's recovery unit.

A nonsulfur-based semichemical process was developed in the late 1960s by Owens-Illinois Inc. This system uses a solution of sodium hydroxide and soda ash to produce a semichemical pulp equivalent in quality to NSSC pulp. It is adaptable to existing processes with only minor modifications. More than half of all NSSC pulp producers have shifted to the no-sulfur, soda-based cook.

MECHANICAL PULPING

In the mechanical process, pulpwood (roundwood or chips) is converted to pulp by mechanical energy. Mills first used the groundwood modified process, but it is no longer the most prevalent by a small margin. Short logs are fed against a rotating disc called a grinder. Fibers and bundles of fibers are ground off and then sluiced with water into a chest beneath the grinder. The high temperature created by the meeting of grinder and log has a plasticizing effect on lignin, thus reducing the energy needed to loosen fibers from the wood mass. It also prevents excessive damage to the fibers, which are short and choppy but of a very high yield (+90%). These pulps are refined to remove shives and bundles and to develop strength properties.

Groundwood pulps are ideal for bulky sheets that require good opacity, such as newsprint and low-quality printing grades. Because these pulps have poor sheet

U.S. PULP MILLS—SUMMARY OF STATISTICS

Year[1]	All establishments		Employees		Value added by manufacture (million $)	Cost of materials (million $)	Value of shipments (million $)	New capital expenditures (million $)
	Total (number)	With 20+ employees (number)	Number (000)	Payroll (million $)				
1987 Census	39	38	14.2	$536.3	$2,246.0	$1,954.9	$4,213.9	$358.4
1986 ASM	n.a.	n.a.	15.3	593.7	1,590.8	2,212.7	3,837.3	874.6
1985 ASM	n.a.	n.a.	16.3	555.4	1,133.1	2,095.0	3,228.0	745.0
1984 ASM	n.a.	n.a.	16.8	549.0	1,599.4	2,267.3	3,841.1	600.4
1983 ASM	n.a.	n.a.	16.9	508.7	1,239.4	2,003.8	3,261.4	915.7
1982 Census	43	41	16.7	467.5	1,113.8	1,986.5	3,129.0	658.6
1981 ASM	n.a.	n.a.	15.9	408.1	1,221.7	1,960.1	3,141.8	521.5
1980 ASM	n.a.	n.a.	16.2	404.6	1,292.7	1,776.9	3,031.9	258.8
1979 ASM	n.a.	n.a.	15.7	338.9	1,117.2	1,417.2	2,544.1	239.7
1978 ASM	n.a.	n.a.	15.1	306.3	855.5	1,268.0	2,152.4	194.6
1977 Census	45	42	16.2	293.2	885.7	1,212.4	2,071.1	301.1
1976 ASM	n.a.	n.a.	15.7	260.5	974.6	1,087.7	2,055.4	375.0
1975 ASM	n.a.	n.a.	13.1	191.4	821.0	837.0	1,630.4	294.2
1974 ASM	n.a.	n.a.	12.0	163.2	779.3	766.1	1,525.2	135.6
1973 ASM	n.a.	n.a.	10.8	138.2	382.7	464.0	848.5	118.7
1972 Census	60	35	10.6	125.7	306.9	388.1	709.9	136.4
1971 ASM	n.a.	n.a.	14.5	156.3	367.2	496.4	841.8	135.2
1970 ASM	n.a.	n.a.	15.6	160.2	466.3	508.3	960.3	121.6
1969 ASM	n.a.	n.a.	14.9	142.6	362.0	455.2	820.0	132.6
1968 ASM	n.a.	n.a.	15.4	136.0	361.3	431.2	799.3	77.0
1967 Census	61	43	15.1	125.6	333.7	403.2	730.5	121.8
1966 ASM	n.a.	n.a.	14.8	112.3	346.1	320.1	658.5	113.3
1965 ASM	n.a.	n.a.	14.8	112.3	346.1	320.1	758.5	112.2
1964 ASM	n.a.	n.a.	15.3	113.6	331.6	328.6	662.8	66.6
1963 Census	45	40	15.1	107.4	295.8	312.6	609.1	38.9

n.a. = Not available.

1. In years of Annual Survey of Manufactures (ASM), data are estimates based on a representative sample of establishments canvassed annually and may differ from results of a complete canvass of all establishments.

Source: *1987 Census of Manufactures.*

strength, kraft or high-yield sulfite pulp must be added to grades such as newsprint so they can run on paper machines and printing presses. North American groundwood pulp capacity for paper and board production is about 8.2 million metric tpy.

Because grinders must accept logs, it is impractical to use chips for mechanical pulp production. In the early 1960s, mills discovered that chips could be refined, with or without preheating, in large disc refiners that discharge to the atmosphere. The resulting pulps tend to have longer fiber lengths than groundwood-prepared pulps from the same species. Consequently, they have somewhat better strength but slightly lower opacity. This process, called refiner mechanical pulping (RMP), opened the way for mills, especially in the Pacific Northwest, to use residual chips for the production of mechanical pulps. North America has about 700,000 metric tpy of RMP capacity.

In the late 1960s, mills learned that if chips were presteamed and refined under pressure in a disc refiner, a much higher quality of pulp could be obtained. This process, called thermomechanical pulping (TMP), allows mills to produce a stronger pulp than previously thought possible with mechanical processes. In a typical TMP process, softwood chips are presteamed at 110°C (230°F) for 1 or 2 min. Next, they are fed via a press feeder or pocket feeder into a pressurized refiner with specially designed plates, and then they are released under pressure into a stock chest. These pulps are further refined in a second stage.

Within the last decade, several modifications have been made to the TMP process. Some of these processes use chemicals (usually sodium sulfite at various pHs) before and after the TMP stage. Some involve steaming and non-pressurized first-stage refining, while others use no steaming and pressurized refining.

The most important of these variations is the chemithermomechanical pulping (CTMP) process developed in Scandinavia during the late 1970s. CTMP differs from TMP mainly in its use of equipment for chip impregnation with chemicals prior to refining.

The process usually begins with an impregnation of 2% to 5% of sodium sulfite and chelating agents with a pH of 9 to 12. Next comes preheating for 2 to 5 min at 120° to 130°C, followed by refining. For softwood, the unbleached yield is 92% to 96%, depending on the raw material and amount of chemicals used. With peroxide bleaching, a brightness level of about 80 to 82 ISO can be reached for

CANADIAN PRODUCTION OF WOODPULP

(000 metric tons)

Year	Total all grades[1]	Dissolving and special alpha	Bleached sulfite	Unbleached sulfite	Bleached hardwood sulfate	Bleached softwood sulfate	Semibleached sulfate	Unbleached sulfate	Semichemical	Mechanical
1989	23,701	273	415	1,212	1,577	6,868	1,055	1,350	432	10,506
1988	23,801	266	441	1,298	1,407	6,970	1,100	1,457	424	10,422
1987	23,123	241	454	1,296	1,324	6,887	1,169	1,474	440	9,820
1986	21,798	223	428	1,248	1,299	6,324	1,188	1,410	406	9,252
1985	20,481	222	329	1,269	1,174	5,873	1,170	1,383	330	8,714
1984	20,417	221	365	1,405	1,214	5,568	1,065	1,469	410	8,682
1983	19,455	216	304	1,353	1,050	5,693	1,019	1,486	382	7,934
1982	17,237	219	280	1,446	817	5,098	916	1,235	319	6,888
1981	19,326	274	430	1,819	812	5,449	1,057	1,497	322	7,647
1980	19,985	313	405	1,763	832	5,922	1,185	1,689	333	7,521
1979	20,331	311	478	1,806	811	5,471	1,038	2,061	354	7,956
1978	19,783	341	516	1,787	785	5,086	1,054	1,942	318	7,910
1977	17,925	230	636	1,621	680	4,620	1,039	1,574	263	7,226
1976	17,687	222	609	1,649	594	4,672	1,038	1,559	269	7,037
1975	14,850	226	516	1,442	452	3,767	863	1,314	233	6,007
1974	19,359	333	734	1,865	777	4,632	1,096	1,942	329	7,588
1973	18,218	293	507	1,750	893	4,155	1,097	1,922	350	7,196
1972	17,123	370	526	1,711	835	3,556	1,127	1,639	337	6,967
1971	16,235	388	587	1,706	723	3,130	1,150	1,467	301	6,718
1970	16,350	411	684	1,870	3,660[2]		1,084	1,341	285	6,940
1965	13,050	431	817	1,836	1,862		566	1,114	177	6,170
1960	10,255	356	519	1,560	1,062		257	895	203	5,335
1955	9,082	265	566	1,625	663		55	617	141	4,960
1950	7,606	305	386	1,315	396		12	548	94	4,445

1. Excludes defibrated and exploded pulp (51,000 tons in 1986) used mainly in construction grades; about 15,000 tons of screenings are included.
2. Total bleached softwood and hardwood production.
Source: *Statistics Canada*.

softwood CTMP. For hardwood, brightness can go as high as 87—almost equal to bleached kraft pulp.

Chemical pretreatment of chips gives CTMP the following advantages over TMP: 1) less destructive separation of fibers from the wood, resulting in a higher, longer fiber content and a much lower shive content; 2) more flexible fiber, which is reflected in higher sheet density and higher burst and tensile strength; 3) higher brightness level before bleaching; 4) more efficient removal of wood extractives, which makes CTMP better suited for absorbent grades and food packaging.

Compared with chemical pulp, bleached softwood kraft has higher tensile strength, while CTMP has better opacity. Tear strength is about the same for both grades. The most serious drawback of mechanical pulps is color reversion.

Most TMP and CTMP are now being used in newsprint, uncoated groundwood, and coated publication papers. These pulps permit newsprint mills to reduce or even eliminate chemical pulp content in their furnishes. High-freeness, mainly softwood CTMP is also being used in absorbent products (towels and baby diapers) and in bleached board. Several new Canadian market pulp mills are marketing low-freeness, aspen CTMP grades for use in coated and uncoated free-sheet grades. Some of these mills have two lines to produce both high- and low-freeness pulp. This permits fines from the high-freeness line to be transferred to the low-freeness line. Likewise, long fibers from the latter may be moved to the high-freeness line.

As the fastest-growing pulping processes, TMP/CTMP is now more predominant than groundwood in mechanical pulping. North America currently has about 8.8 million metric tpy of TMP/CTMP capacity, and growth is expected to continue. One drawback of TMP/CTMP is its high energy requirement. Methods such as pressurized cyclone are being developed to improve the recovery of steam, which can be used in drying pulp or paper.

Despite the waning popularity of groundwood pulping, Tampella Oy of Finland and MoDoCell of Sweden introduced a new innovation in the late 1970s—pressurized groundwood (PGW) pulping. PGW differs from conventional grinding because the grinding occurs under pressure that permits shower water to be heated to higher temperatures (over 95°C). The higher temperatures soften the lignin and permit woodfiber to be released with less damage.

Pulp produced by this process has strength values approaching those of TMP, with only two-thirds the power consumption, or about the same amount of power required by conventional groundwood. PGW is used at more than 20 mills in Europe, North America, and Japan, and it represents more than 2 million metric tpy of capacity. In North

CANADIAN WOODPULP CAPACITY

(000 metric tons)

Year	Total* all grades	Dissolving and special alpha	Bleached sulfite	Unbleached sulfite	Bleached softwood sulfate	Semi-bleached softwood sulfate	Bleached hardwood sulfate	Unbleached sulfate	Semi-chemical	Mechanical
1992e	28,944	250	548	1,151	8,242	914	2,194	1,553	519	13,573
1991e	28,272	250	540	1,147	8,078	911	2,117	1,550	512	13,167
1990e	26,844	257	573	1,170	7,757	937	1,830	1,550	499	12,271
1989	25,736	281	538	1,293	7,444	939	1,697	1,540	464	11,540
1988	25,021	277	452	1,399	7,410	962	1,595	1,561	465	10,900
1987	24,740	245	466	1,446	7,201	1,082	1,367	1,543	465	10,445
1986	24,509	245	582	1,438	7,023	1,123	1,279	1,682	456	10,201
1985	23,423	266	572	1,414	6,804	1,085	1,253	1,719	449	9,861
1984	23,305	264	371	1,634	6,578	1,127	1,311	1,735	472	9,813
1983	22,889	267	391	1,734	6,492	1,169	1,121	1,734	462	9,519
1982	22,618	305	436	1,950	6,336	1,236	988	1,759	445	9,163
1981	22,424	303	461	2,119	6,371	1,106	955	1,788	445	8,876
1980	21,864	307	426	2,062	6,252	1,198	879	1,752	438	8,550
1979	22,521	395	512	2,100	6,114	1,258	866	1,807	459	9,010
1978	22,014	424	580	2,091	5,699	1,216	852	1,824	455	8,837
1977	22,251	353	727	2,119	5,535	1,191	848	2,062	454	8,924
1976	22,242	408	807	2,134	5,329	1,189	860	2,157	426	8,894
1975	21,960	427	794	2,131	5,256	1,203	877	2,132	400	8,696
1974	21,641	404	689	2,144	5,027	1,264	867	2,087	390	8,716
1973	20,957	416	622	2,107	4,651	1,249	844	1,967	392	8,652

*Includes screenings; excludes mechanical pulp for paper and board.
e = Estimate.
Source: Canadian Pulp & Paper Assn.

America, Madison Paper Co. and Lake Superior Paper Industries use the process to produce supercalendered paper, while Blandin Paper Co. and James River Corp. (St. Francisville, La.) use it to make lightweight coated paper.

DEFIBRATED PULP PROCESS

The defibrated pulp process is the simplest way of preparing pulp, and it gives the highest yield with less pollution, but defibrated pulp has very poor strength characteristics. It can be prepared from either softwoods or hardwoods, depending on the product and the availability of timber. Defibrated pulp was first prepared by the Masonite process, which steams chips under pressure in a vessel and releases them via a gun or nozzle to atmospheric pressure. The explosion literally blows the pulp into individual fiber masses, which are mixed to make a pulp slurry. This slurry can make coarse grades of paper and board with little or no extra refining. It is ideally suited for making insulation and hardpressed board.

In the late 1930s, Defibrator AB of Sweden developed the defibrated pulping process. In this process, pulp is fed continuously to a presteaming vessel under slight pressure and reasonably high temperature, then discharged through a pressurized refiner at the bottom or end of the pulping vessel, where it is defibrated under pressure. Next, the pulp is discharged to atmospheric pressure to either a live-bottom storage bin or a stock chest, where it is diluted to make a stock slurry. If necessary, the pulp is again refined, mainly to break up fiber bundles and to develop strength characteristics. It is then fed to either a cylinder- or fourdrinier-type former.

THERMOMECHANICAL PULPING CAPACITY TRENDS IN U.S. AND CANADA

(000 metric tons)

Year	Canada*	U.S.	Total
1992e	8,323	3,451	11,774
1991e	7,940	3,402	11,342
1990e	6,969	3,195	10,164
1989	5,751	2,931	8,682
1988	5,062	2,812	7,874
1987	4,375	2,691	7,066
1986	4,122	2,413	6,535
1985	3,811	2,267	6,078
1984	3,563	2,225	5,788
1983	3,135	1,985	5,120
1982	2,383	1,858	4,241
1981	1,738	1,563	3,301
1980	1,115	1,244	2,359
1979	717	791	1,508
1978	544	652	1,196
1977	533	514	1,047
1976	380	302	682
1975	69	119	187

Note: Table figures changed to metric tons for this edition.
*Includes chemi-thermomechanical pulp.
e = Estimate.
Sources: Canadian Pulp & Paper Assn., American Paper Institute.

If the fiber from this process is to be used in a dry process such as hardpressed board production, it is not diluted with water. Instead, it is stored in a live-bottom bin and then fed through a distributor line onto a forming wire. The capacity for making defibrated pulp has grown rapidly during the last 20 years.

DEINKING PROCESS

Deinking is the process of removing inks—and in some cases, coating and filler—from wastepapers that are primarily newspaper and coated ledgers. Deinking is mostly done at nonintegrated paper mills in two processes: flotation and washing. In the washing system, wastepaper is pulped with chemicals (soda ash, caustic soda, sodium silicates, surfactants, or solvents) in an open pulper either on a continuous or batch basis. The pulp is washed free of ink on conventional rotary washers or on side-hill screens. The washed pulp is then screened and bleached.

Flotation deinking uses air to float off ink particles from the fibers. The wastepaper is first sent to a pulper with deinking chemicals, cleaned with screens and centrifugal cleaners, and then deinked with flotation cells. Chemicals typically used are sodium peroxide, silicates, foamers (soaps), and a collector.

In addition to the two main systems—flotation and washing—several other deinking systems are used. Three combination processes have a washing system coupled with a flotation unit to clean effluent from the washers. Regardless of the type of system, the pulper is usually run batch, while the deinking line draws from a storage tank and is run continuously. However, some systems take pulp out of the pulper continuously and run the deinking line continuously as well.

Over 50 mills in North America deink wastepaper. More than 45 of them are in the U.S., and about six are in Canada. Tissue mills (approximately 20 installations) account for nearly half of all deinking mills. Fort Howard Corp. is a leader in deinked tissue production, using proprietary technology to process less expensive wastepaper grades. Deinked pulp lines exist at about five North American printing/writing mills, four linerboard and boxboard mills, and nine newsprint mills. Garden State Paper Co. is the leading U.S. producer of recycled newsprint. Four mills owned by Ponderosa Fibres of America, with a combined capacity of 800 tpd, produce deinked market pulp. Riverside Paper Co. has a unique solvent-extraction system that is used on wastepaper such as cupstock, milk carton stock, and other difficult-to-clean waste.

NEW PULPING PROCESSES

Interest is growing in the use of organic solvents, such as ethanol and methanol, to remove lignin. The concept of organosolv pulping was first proposed in the early 1930s, but

GENERAL DESCRIPTION OF COMMERCIAL PROCESSES FOR PULPING WOOD

Pulp classification	Name of process	Process description	Woods used	Yield of pulp by weight (%)	Strength, brightness[1]	Pulp usage	Final products	U.S. capacity 1990 (000 short tons)	Number of pulp mills in U.S. 1989[2]
Dissolving	Pre-hydrolyzed kraft	Woodchips first receive an acid or water hydrolysis to remove pentosans and then are pulped via kraft process. Very high alpha grades receive a cold caustic treatment after kraft pulping.	Softwoods: southern pine. Hardwoods: gum, oak, southern mixed hardwoods.	30-35	Low	Chemically converted into chemicals, plastics, rayon, cellophane, or acetates.		840e	3
	Sulfite	Woodchips first are pulped under special acid sulfite pulping conditions. Higher purity achieved via pressure heat treatment or cold caustic treatment stages.	Softwoods: southern pine, hemlock, spruce. Hardwoods: eastern.	30-35	Low	Same as above.		650e	5
Chemical	Kraft	Woodchips reduced under steam pressure to pulp with alkaline chemicals (sodium hydroxide and sodium sulfide).	Softwoods	42-55 90 ISO bright	Softwoods: high to very high. Hardwoods: medium to medium high.	Higher yield pulp used for containerboard. Lower yield pulp used for numerous grades of paper. Often mixed with other pulps.	Strong wrapping and bag paper, containerboard, book, newsprint, highest grade magazine and other printing papers, bond, writing	Total: 50,896 Bleached and semi-bleached softwood: 14,674 Hardwood: 13,202	124
			Hardwoods	44-49					
	Sulfite	Woodchips reduced under steam pressure to pulp with an acid chemical (calcium, magnesium, sodium, or ammonium bisulfite plus sulfurous acid).	Softwoods: spruce, balsam, hemlock, southern pine. Hardwoods: eastern lake.	46-48 90 ISO bright	Softwoods medium to high.	Usually mixed with other pulps. When purified, used for cellulose products.	Book and magazine, wrapping, tissue, newsprint, glassine, writing, cellulose	1,622	18

GENERAL DESCRIPTION OF COMMERCIAL PROCESSES FOR PULPING WOOD (continued)

Pulp classi-fication	Name of process	Process description	Woods used	Yield of pulp by weight (%)	Strength, brightness[1]	Pulp usage	Final products	U.S. capacity 1990 (000 short tons)	Number of pulp mills in U.S. 1989[2]
Mechanical	Groundwood (GWP)	Wood bolts reduced to pulp by pressing on a revolving grindstone.	Softwoods: spruce, balsam, pine, hemlock. Hardwoods: aspen, cottonwood.	91-93	Low 70 bright	Usually mixed with chemical pulp.	Newsprint, magazine, book, catalog, tissue/towel, boxboard, building, insulating board	3,241	71
	Refiner mechanical (RMP)	Woodchips are mechanically fiberized in non-pressurized disc refiners.	Same as GWP	91-93	Low but higher than GWP	Blended with GWP or chemical.	Newsprint	342	6
	Thermo-mechanical (TMP)	Woodchips are first presteamed and fiberized in pressurized disc refiners.	Same as GWP	90	Low but higher than RMP, 80 bright	Same as above.	Newsprint, publication papers, fiberboard	3,522	25e
	Chemi-thermo-mechanical (CTMP)	Woodchips are impregnated with 2% to 5% sodium sulfite prior to refining; otherwise, similar to TMP.		91-93	Higher than TMP, lower than kraft 80-82 bright (swd) 85+ (aspen)	Same as above.	Newsprint, publication papers, tissue/towel, bleached board, fluff	30 (2,800e in Canada)	1 (15+ in Canada)
	Pressurized groundwood (PGW)	Groundwood made by grinding logs in a pressurized atmosphere with grinder at high temperature.	Same as GWP	90-93	Nearly as high as TMP; higher than groundwood	Same as GWP.	Supercalendered papers, coated groundwood	600	7

n.a. = Not available.
e = Estimate.

[1] ISO brightness.

[2] Except for kraft, sulfite, and chemi-thermomechanical pulp, nearly every kind of pulp mill must be integrated with a paper or board mill, with excess production being offered for sale.

GENERAL DESCRIPTION OF COMMERCIAL PROCESSES FOR PULPING WOOD (continued)

Pulp classification	Name of process	Process description	Woods used	Yield of pulp by weight (%)	Strength, brightness[1]	Pulp usage	Final products	U.S. capacity 1990 (000 short tons)	Number of pulp mills in U.S. 1989[2]
Chemical (cont.)	Soda	Woodchips reduced under steam pressure to pulp with an alkaline chemical (caustic soda).	Mostly hardwoods: aspen, cottonwood, basswood, beech, birch, maple, oak, tupelo (gum)	40-48	Medium to medium low	Often mixed with sulfite and other pulps.	Book and magazine, lithograph, other printing papers, envelope, blotting paper	312e	2
Semi-chemical	Neutral sulfite, bisulfite, acid sulfite, kraft, soda, or caustic	Woodchips partially softened under steam pressure with chemicals are reduced to pulp by mechanical action.	Hardwoods: same as for soda pulp. Red alder. Often pulped in mixtures. Softwoods: small amounts of Douglas fir, ponderosa pine, and sugar pine.	60-80	Medium to medium low	Alone in corrugating and some other boards. Bleached pulps mixed with softwood pulps for other products.	Corrugating board, food and other specialty boards, glassine magazine, newsprint, insulating and sheathing board	4,925	36
Chemi-mechanical	Mason (exploded) Asplund (defibrated)	Woodchips treated with steam or hot water at high temperatures and pressures to soften the wood, followed by mechanical fiberization.	Softwoods and hardwoods	80-95	Low to very low	Coarse pulps composed of mixture of single fibers and fiber bundles used alone and mixed with other pulps.	Hardboard, insulating, roofing and linoleum felts	600e	25e
	Cold soda	Woodchips given mild treatment with sodium hydroxide solutions and then mechanically fiberized to pulp.	Hardwoods: birch, maple, beech, oak, sweetgums, aspen. Bagasse. Often pulped in mixtures.	80-95	Medium to low	Often mixed with other pulps.	Printing paper	200e	4e

such processes have only recently come close to commercial development.

With assistance from the Canadian federal government in early 1989, Repap Enterprises Inc. started up a 33-tpd demonstration plant for its Alcell process at Miramichi, N.B. The process uses ethanol and water to dissolve lignin from hardwood chips in an extractor under controlled temperatures and pressures. The lignin separation and liquor recovery system then separates byproducts (sulfur-free lignin and wood sugars) and recycles the ethanol back to the extraction stage. Repap is considering the feasibility of scaling up the process to a 250-tpd commercial facility.

Another variation of the process has been developed in Fed. Rep. Germany, where a 5-tpd demonstration plant has been operating for several years. The MD Organocell process uses methanol and can be used to pulp softwood chips. An 85-tpd system using this process is being installed at an existing paper mill. Advantages of organosolv pulping include lower capital costs, feasibility of smaller-size "mini-mills," minimal environmental impact due to the absence of chlorine, and production of potentially valuable byproducts. The process, however, requires complex pulp-washing arrangements. Volatile pulping chemicals are also used, which can lead to explosions or fires, and the process may not work well on mixed wood species, according to some independent researchers.

The use of anthraquinone (AQ) as a catalyst in kraft and soda pulping has been developed by C-I-L Inc. of Montreal. Mill trials have shown that this organic chemical, when applied in a ratio of about 0.10% to 0.15% to softwood during kraft pulping, typically improves yield by 2% to 3%. It also reduces alkali consumption by 10% to 15% and shortens cooking time. AQ apparently speeds up the removal of lignin, allowing the pulp to retain more hemicellulose.

DESCRIPTIONS OF MECHANICAL PULPING PROCESSES

Groundwood pulp (GW). Groundwood produced by atmospheric grinding of logs with conventional stone grinder.

Pressurized groundwood (PGW). Groundwood produced by grinding logs in a pressurized atmosphere with a conventional grinder.

Groundwood from chips (FGP). Groundwood produced by atmospheric grinding of chips with a modified grinder. There is no common abbreviation: the FGP is used by the Japanese inventors—F for fine, and GP for groundwood pulp.

Refiner mechanical pulp (RMP). Atmospheric refining of untreated chips.

Chemirefiner mechanical pulp (CRMP). Atmospheric refining of chemically treated chips.

Chemi-thermomechanical pulp (CTMP). Produced from chips pretreated with chemicals prior to steaming, then refined in pressurized refiner, with or without subsequent pressurized or atmospheric refining stages.

Thermomechanical pulp (TMP). Produced from chips first presteamed and refined in one or more stages of pressurized refining, or followed by atmospheric refining.

Sodium-sulfite-treated TMP (Opco TMP). Process developed by Ontario Paper Co. that involves treating (cooking) TMP pulp (rather than chips before refining) with sodium sulfite.

Sulfonated chip mechanical pulping (SCMP). Patented process of CIP Inc. that is basically chemical pretreatment of chips followed by atmospheric refining. (Abitibi-Price and Stone-Consolidated both have variations of this process; S-C refers to its process as "Ultra High Yield [UHY]," but this process might be called sulfite pulp or CRMP.)

Tandem TMP. Refers to an arrangement of refiners. For example, single stage only (pressurized); two stages (first only pressurized); three stages (only first pressurized).

Fiber:

MARKET PULP

More than three-quarters of the world's woodpulp never leaves the mill in which it is produced; instead, it is used in another part of the facility to make paper and paperboard. In some cases, however, a paper mill may not produce a certain type of pulp, or it may be a "nonintegrated" facility with no pulping capacity of its own. As a result, the paper mill will fill its requirements from other mills in its own corporate network, or it will purchase pulp from outside "market pulp" suppliers.

Market pulp is defined as woodpulp produced for sale in open competition with pulp from other producers. It excludes tonnage that is consumed by the producing mill or shipped to any of its affiliated mills within the supply region. With one exception, all pulp exported from supplying countries, including pulp shipped to affiliated enterprises in other countries, is considered market pulp. The exception is the substantial volume of pulp produced in Canada for delivery to affiliated companies in the U.S. These deliveries, amounting to about 1.1 million metric tons in 1989, are considered "tied" pulp and are not included in market pulp statistics. There is some question, however, as to whether additional pulp exports should also be considered "tied" considering the increasing investment by Japanese companies in the Canadian pulp industry and North American and Nordic investments in the European paper industry. Market pulp is divided into two basic groups: 1) dissolving or special alpha pulps and 2) paper-grade pulps. Dissolving and special alpha pulps have a high alpha (pure cellulose) content and are used to make rayon, acetate, and other cellulose derivatives as well as specialty papers. Most paper-grade market pulps are produced by chemical processes, although some are made by mechanical methods such as stone groundwood, thermomechanical (TMP), and chemithermomechanical (CTMP) pulping.

Chemical paper-grade pulps produced in North America can be further divided according to pulping process (sulfate/kraft or sulfite), basic wood type (softwood or hardwood), production region (northern or southern), and brightness level (bleached, semibleached, or unbleached). The four most important grades of chemical paper-grade pulp are (in descending order of quality, as measured in terms of price) bleached northern and southern softwood and bleached northern and southern hardwood. Fluff pulp (mainly bleached softwood kraft) goes into nonpaper applications, such as baby diapers, but it is included in paper-grade pulp for statistical purposes.

Papermakers in North America have a widening range of market pulps to choose from as they try the least costly blend of fibers. Eucalyptus pulp from Brazil and the Iberian countries is being increasingly accepted for making tissue and other grades. Canadian bleached chemi-market thermo-

STATISTICS FOR MARKET PULP

(000 metric tons)

	1991e	1990e	1989
U.S.			
Production	6,975	6,680	6,571
Capacity[1]	7,462	7,100	6,890
Utilization rate, %	93.5	94.0	95.4
Apparent U.S .consumption	5,555	5,416	5,284
Imports	2,880	2,752	2,785
Exports	4,300	4,016	4,072
CANADA			
Production	6,906	6,550	7,089
Capacity[1]	7,910	7,592	7,429
Utilization rate, %	87.3	86.3	95.4

e = Estimate.

[1] Based on 1989 American Paper Institute and Canadian Pulp & Paper Assn. capacity surveys.

mechanical pulp (BCTMP) has become available in both softwood and aspen varieties. An increasing amount of recycled market pulp is beginning to enter the market as papermakers respond to pressure to use more wastepaper in their furnish. And papermakers are beginning to substitute more minerals for fiber in their furnishes. One pound of calcium carbonate can replace about 1.2 lb of fiber in making uncoated free-sheet paper, and it is less expensive.

Most paper-grade market pulp is cut into sheets and sold in bale form, but some is sold in rolls, and a small amount is flash-dried and baled. Integrated paper mills can sell captive pulp on the open market when internal pulp demand is low. When pulp demand is high, these integrated mills may become net pulp buyers or may shift tonnage to affiliated paper mills. Dissolving pulp mills produce either chemical cellulose or paper-grade pulps. As a result, market pulp capacity ratings are inexact and vary with market conditions.

GRADES OF CHEMICAL PAPER-GRADE MARKET PULP

Bleached sulfate (kraft) is the predominant grade of market pulp, with Canadian and U.S. production in 1989 totaling 13.6 million metric tons (including semibleached pulp). The largest percentage of production is made from softwood fibers such as spruce, fir, and pine. Bleached softwood kraft output totaled 5.7 million tons in Canada and 3.6 million tons in the U.S. in 1989. The most preferred softwood pulps generally are those from mills in western and eastern Canada, the northeastern U.S., and, to a lesser extent, the U.S. Pacific Northwest (where some mills use less desirable species such as pine and redwood).

Southern U.S. pine pulps are somewhat lower in quality, as the fiber is coarser and produces a poorer sheet for printing/writing grades. With increasing availability, however, papermakers have learned how to use larger percentages of southern pine pulp in most white paper grades. Nevertheless, southern pine pulps in strong markets sell at about a $30/metric-ton discount from northern bleached softwood kraft (NBSK) pulp. In weak markets, the differential may be much larger—recently more than $100/ton.

Bleached hardwood kraft market pulps are produced in the U.S. Northeast and South, with a small amount also produced in eastern Canada. Hardwood accounts for about 40% of U.S. and 14% of Canadian bleached sulfate market

U.S. PRODUCTION OF MARKET WOODPULP

(000 metric tons)

Year	Total all grades	Dissolving and special alpha	Bleached sulfate (kraft)[1] Total	Bleached sulfate (kraft)[1] Softwood	Bleached sulfate (kraft)[1] Hardwood	Unbleached sulfate	Sulfite
1989	7,868	1,290	6,217	3,674	2,543	146	215
1988	7,776	1,238	6,040	3,560	2,480	251	241
1987	7,373	1,187	5,799	3,428	2,357	166	222
1986	6,849	1,138	5,385	3,295	2,090	140	204
1985	6,156	1,063	4,756	3,075	1,681	135	202
1984	6,245	1,093	4,775	3,035	1,740	139	238
1983	5,911	1,145	4,430	2,752	1,678	128	208
1982	5,200	988	3,914	2,558	1,356	111	187
1981	5,626	1,224	4,030	2,559	1,471	131	241
1980	5,865	1,366	3,971	2,480	1,491	119	345
1979	5,151	1,360	3,381	2,084	1,298	102	250
1978	4,647	1,273	2,985	1,785	1,200	88	227
1977	4,358	1,327	2,626	1,673	953	124	211
1976	4,413	1,243	2,721	1,659	1,062	102	287
1975	3,953	1,118	2,423	1,777[1]	891[1]	79	292
1974	4,663	1,461	2,635	1,428[1]	1,093[1]	173	360
1973	4,468	1,356	2,552	1,384[1]	1,040[1]	100	441
1972	4,559	1,519	2,454	1,300[1]	1,023[1]	106	436
1971	4.204	1,524	2,109	1,096[1]	842[1]	200	378
1970	4,491	1,555	2,487	1,190[1]	1,075[1]	330	534
1965	3,486	1,347	1,298	n.a.	n.a.	214	563
1960	2,717	1,019	897	n.a.	n.a.	262	526
1955	2,429	880	767	n.a.	n.a.	204	551
1950	1,454	428	261	n.a.	n.a.	113	604

n.a. = Not available.

1. Includes semibleached and soda pulp.

Source: American Paper Institute.

pulp production. Canadian and U.S. hardwood normally sells at about a $10/metric-ton premium to southern U.S. hardwood. Southern hardwood pulps are usually sold as mixed hardwoods, which may include oak. Oak and other species high in vessels cause excess picking on offset printing grades, although papermakers have reduced the picking tendency so that problems are not too serious for printers.

Hardwood pulps, blended with or without softwood pulps, make an excellent printing/writing grade, providing bulk and a good printing surface. Hardwood kraft market pulps are generally sold at a $20 to $30/ton discount from softwood kraft grades produced in the same region, but in weak markets the differential grows.

A newer type of hardwood pulp not produced domestically but increasingly popular in North America and around the world is bleached eucalyptus kraft pulp. About 15% of U.S. hardwood pulp consumption now consists of eucalyptus pulp from Brazil, with another 1% to 2% from Spain and Portugal. Since breaking into the world pulp scene about a decade ago, eucalyptus shipments have grown from 434,000 tons in 1976 to about 3 million tons currently. Originally, its popularity was due to lower costs combined with desirable performance features ranging from opacity in printing/writing papers to softness in tissue. As a result, eucalyptus has become a preferred pulp, selling at a price at least equal to the best northern hardwood grades in Europe and the U.S.

Of the estimated 3.2 million tons of bleached eucalyptus market pulp capacity in the world in 1988, about 38% was held by Brazil, 30% by Spain, 25% by Portugal, 4.6% by South Africa, and 2.5% by Morocco. Eucalyptus can be grown rapidly on plantations. The time required for a eucalyptus plantation to reach maturity in Brazil is about seven years, compared with roughly 20 years for southern U.S. loblolly pine and perhaps 80 years or more for Canadian spruce and fir. According to Ronald J. Slinn, vice president, Pulp Materials & Technology Group of the American Paper Institute, eucalyptus plantations in Brazil will produce more than 40 m³/hectare annually—about 20 times the growth rate of the average Canadian forest and almost three times that of a U.S. southern forest. Productivity in Spain and Portugal is somewhat lower than in Brazil but still higher than in the southern U.S.

North American market sulfite pulp production in 1950 exceeded sulfate production, and for many years, sulfite pulps were considered the most desirable type for paper-

U.S. MARKET WOODPULP CAPACITY

(000 metric tons)

			Total					
				Bleached sulfate (kraft)[1]				
Year	Total all grades	Dissolving	Chemical paper grade	Softwood	Hardwood	Unbleached sulfate	Sulfite	Others
1992e	9,418	1,356	8,037	4,680	2,956	172	229	25
1991e	8,838	1,356	7,462	4,228	2,834	172	229	19
1990e	8,468	1,356	7,100	3,972	2,728	172	229	12
1989e	8,247	1,356	6,887	3,788	2,699	172	229	4
1988	8,081	1,315	6,759	3,703	2,639	170	248	6
1987	7,716	1,259	6,444	3,646	2,388	152	257	13
1986	7,293	1,266	6,015	3,398	2,224	132	260	13
1985	7,247	1,312	5,923	3,386	2,133	131	274	13
1984	6,831	1,349	5,469	5,063		132	274	13
1983	6,726	1,378	5,335	4,874		142	319	13
1982	6,422	1,450	4,986	4,572		129	261	11
1981	6,325	1,432	4,876	4,416		151	309	15
1980	6,170	1,430	4,653	4,163		156	335	87
1979	5,746	1,407	4,247	3,836		94	318	92
1978	5,213	1,427	3,691	3,314		97	280	94
1977	4,960	1,461	3,498	2,975		149	273	101
1976	4,905	1,289	3,616	2,896		198	416	105
1975	4,910	1,350	3,560	2,919		192	417	31
1974	5,041	1,484	3,557	2,940		173	427	17
1973	4,867	1,442	3,425	2,814		134	458	18
1972	4,910	1,560	3,349	2,774		124	451	—
1971[2]	4,498	1,597	2,901	2,251		218	432	—

e = Estimate.

1. Includes semibleached.

2. First year in which market pulp capacity was reported by API.

Source: American Paper Institute.

making. But by 1989, production of bleached and unbleached sulfite market pulp dropped to only 490,000 metric tons, accounting for less than 4% of total North American chemical paper-grade market pulp production. This trend is expected to continue with the shutdown of small, older mills and little new construction of sulfite pulp mills. The same declining trend has developed in the Nordic countries, where sulfite currently accounts for about 9% of chemical paper-grade market pulp capacity.

Most North American sulfite pulp is produced from northern and eastern softwoods (spruce, pine, fir, and hemlock). ITT Rayonier Inc. at Fernandina Beach, Fla., produces paper-grade and dissolving pulp grades from southern pine. A few U.S. and Canadian mills produce sulfite pulp from hardwoods. Sulfite pulps are still highly desirable for producing high-quality tissue and printing/writing papers.

Unbleached kraft market pulp production has declined in North America. Total 1989 production of 277,000 tons accounted for only about 2% of North American chemical paper-grade market pulp production. About 30% to 40% of unbleached kraft market pulp in the U.S. is used in one-time carbonizing tissue, a market that is shrinking due to inroads by carbonless copy paper. Other end uses for unbleached kraft market pulp are filter papers, cable wrap, condenser papers, twisting grades, and other specialties.

MACHINE-DRIED WOODPULP CAPACITY

(000 metric tons)

Year	Total	Dissolving	Sulfite	Bleached sulfate	Unbleached sulfate	Other
1992e	11,556	1,356	439	9,590	196	170
1991e	10,937	1,356	439	8,977	196	164
1990e	10,512	1,356	439	8,559	196	157
1989	10,323	1,356	439	8,379	196	149
1988	10,178	1,315	413	8,303	178	147
1987	9,747	1,265	374	7,999	152	108
1986	9,443	1,269	367	7,568	132	108
1985	9,315	1,313	358	7,417	130	106
1984	8,850	1,349	364	6,904	132	100
1983	8,618	1,455	377	6,555	132	99
1982	8,615	1,457	406	6,521	137	94
1981	8,462	1,450	450	6,291	172	98
1980	8,304	1,442	472	6,052	171	170
1979	7,779	1,393	486	5,625	99	176
1978	7,432	1,427	516	5,204	107	176
1977	7,235	1,495	579	4,818	161	181
1976	7,170	1,425	714	4,642	205	183
1975	7,167	1,516	709	4,608	217	119
1974	7,235	1,655	740	4,555	193	93
1973	6,994	1,596	728	4,392	191	88
1972	6,807	1,593	709	4,266	226	10
1971	6,717	1,605	609	4,173	245	4
1970	6,574	1,604	755	3,977	237	1

e = Estimate.
Source: American Paper Institute.

NORTH AMERICAN INDUSTRY STRUCTURE

The U.S. pulp and paper industry is highly integrated, and market pulp accounts for only a small percentage of total woodpulp production or consumption. Of the 76 U.S. companies that produce paper-grade pulp, only 26 sold any pulp in 1989, according to API. Many of the 229 companies in the U.S. paper industry also buy significant quantities of pulp, but at least 156 of these must purchase all of the fiber they require, including wastepaper.

In 1989, the U.S. paper industry produced 54.9 million metric tons of chemical paper-grade pulp, of which 84% was consumed on site, 4% was shipped to affiliated mills within the U.S., 4% was shipped to the domestic market, and 8% was exported, according to API. Apparent U.S. paper-grade woodpulp consumption in 1989 totaled 55.2 million tons, of which 84% was supplied by integrated sources within the U.S., 4% by U.S. affiliates, 4% by the domestic market, and 8% by imports.

U.S. paper pulp imports in 1989 totaled 4.4 million tons, of which 89% was supplied by Canadian producers. The remaining 11% came from Brazil, the Nordic countries, Chile, Portugal, Spain, and Swaziland.

In 1989, Canadian paper-grade pulp shipments to the U.S. were approximately 3.9 million metric tons, of which 28% was tied shipments from Canadian affiliates of U.S. paper companies.

Market pulp accounts for a larger share of total Canadian chemical paper-grade woodpulp production, which totaled about 12.5 million metric tons in 1989. Of this amount, 34% was consumed on site or by affiliated mills, 7% was shipped as market pulp to domestic mills, 27% was shipped to the U.S. (including roughly 1.1 million tons of tied pulp), and 32% was exported abroad, according to Canadian Pulp & Paper Assn. data. About 30 companies in Canada sell chemical paper-grade market pulp.

U.S. consumption of chemical paper-grade market pulp has grown at a 2% average annual rate over the past decade. Printing/writing papers account for more than half of all chemical paper-grade market pulp consumed in the U.S. But consumption of "white" market pulp has been declining as a percentage of U.S. printing/writing paper production—from more than 35% in the early 1970s to around 27% in 1989. This pattern suggests "that an increasing proportion of new U.S. printing/writing paper capacity is integrated to pulp," according to Slinn. The tissue/towel segment is the second largest source of U.S. demand but has increasingly been turning to use of secondary fiber and BCTMP. Fluff pulp for use in baby diapers and other sanitary products accounts for just under 20% of U.S. chemical paper-grade pulp consumption. The final large end-use segment is specialty packaging and industrial papers made up of mostly small, nonintegrated paper mills.

U.S. demand for market pulp is closely related to the level of U.S. paper production, particularly of printing/writing grades. In recent years, when U.S. printing/writing paper mill operating rates exceeded the low-90% range, the amount of white market pulp consumed in relation to total white pulp usually rose above 20%. If operating rates are below 90%, however, the ratio of market to total paper pulp consumption often drops into the 18%-to-19% range. (White pulp includes bleached and semibleached kraft and bleached and unbleached sulfite.)

The main reason for this swing is that when many integrated companies run at full capacity, they must supplement their own pulp supplies by purchasing fiber on the open market. At the same time, some companies may stop selling pulp in the open market because they must supply their own integrated requirements during a strong market, thus contributing to the cyclicity of the market. However, overall market pulp capacity tends to creep higher in tight markets, as existing mills are debottlenecked or as production is shifted to higher-yield grades (e.g., from softwood to hardwood or from dissolving to paper-grade pulp). U.S. chemical paper-grade market pulp capacity was revised upward by 850,000 metric tpy during the 1987-88 period.

INTERNATIONAL MARKET

The pulp market is international in nature, with large volumes of pulp moving duty-free between net-producing regions and net-consuming regions. North America and the Nordic countries are the largest market pulp producing regions, although nontraditional supplying countries with fast-growing plantations—Brazil, Portugal, Spain, and Chile—are growing in importance.

After rising for six consecutive years, world chemical

U.S. EXPORT TRENDS FOR WOODPULP

(000 metric tons)

Year	Total all grades	Dissolving and special alpha	Sulfite bleached	Sulfite unbleached	Sulfate bleached	Sulfate semibleached	Sulfate unbleached	Other
1989	5,657	759	407[1]	n.a.	4,262[2]	n.a.	165	64
1988	5,016	785	356	27	3,644[2]	n.a.	158	46
1987	4,416	681	338	35	3,197[2]	n.a.	141	24
1986	4,044	645	288	24	2,886	17	131	53
1985	3,443	572	227	20	2,474	37	86	26
1984	3,260	540	239	9	2,272	69	82	49
1983	3,306	587	255	12	2,277	52	87	36
1982	3,080	573	190	7	2,139	57	90	25
1981	3,336	720	247	11	2,193	60	92	22
1980	3,452	698	292	23	2,180	84	103	73
1979	2,662	693	199	34	1,481	97	94	64
1978	2,358	687	172	18	1,270	84	69	56
1977	2,395	722	175	7	1,174	147	95	74
1976	2,284	662	164	11	1,180	95	103	67
1975	2,327	628	223	21	1,427	117	87	38
1974	2,252	714	259	22	1,308	81	141	16
1973	2,126	668	266	6	1,003	114	65	5
1972	2,044	720	205	2	1,092	115	70	3
1971	1,974	717	184	9	787	132	137	8
1970	2,808	778	326	31	1,192	223	230	11
1969	1,907	674	228	13	733	138	115	7
1968	1,738	609	206	8	578	191	134	11
1967	1,561	551	219	12	471	179	120	9
1966	1,404	511	190	24	326	126	99	9
1965	1,272	485	183	35	329	126	155	6

n.a. = Not available.
1. Includes unbleached.
2. Includes semibleached.
Source: U.S. Dept. of Commerce.

paper-grade market pulp shipments declined by 1.6% in 1989 to 26.3 million metric tons, according to David F. McCaffrey, director of woodpulp for CPPA. Shipments from North American and Nordic producers totaled 18.3 million tons, down 2.5% from 1988. Canada remained the single-largest market-pulp-producing country with shipments of nearly 7.0 million tons, down 3.7% from a year earlier. The U.S. was second with shipments of 6.5 million tons, down 0.2%. Nordic shipments totaled 4.8 million tons, down 3.9%. Shipments from non-Norscan supplying countries totaled 8 million tons, down 0.9%.

During the past decade, world shipments of chemical paper-grade pulp have grown at a 2.2% average annual rate. While shipments by North American and Nordic producers grew at a 1.5% rate over the 1980-89 period, deliveries by nontraditional suppliers, led by Brazil and Portugal, have grown more than twice as quickly, according to McCaffrey. As a result, their share of the world total has increased from 26% in 1980 to 30% by 1989. The share held by North American and Nordic producers declined from 74% in 1980 to 70% by 1989 and is expected to continue to decline as substantial new capacity starts up in countries such as Brazil and Chile.

Western Europe (excluding Scandinavia) remains the largest destination for world chemical paper-grade market pulp shipments, accounting for about 40% of total shipments. In 1989, Western Europe consumed 11.0 million tons of pulp, up 0.5% from the previous year. The U.S. was the second largest market, consuming 5.2 million tons, down 6.6% from the previous year. Japan was the third largest market, with demand of 3.2 million tons, up 9.3% from 1988. Other regions of the world—Asia, Latin America, and Africa—consumed nearly 3.9 million tons of market pulp in 1989, down 8% from 1988.

PULP MARKET CYCLES

The pulp market is highly cyclical, characterized by sharp inventory swings and rising or falling prices. When prices begin to go up, buyers rush to stock up on pulp. Rising shipments enable producers to run at full capacity and reduce their inventories. The tighter market emboldens them to demand still higher prices, triggering another surge of buying and another upward spiral in the market cycle.

High pulp prices cause consuming paper mills to use substitutes such as secondary fiber (wastepaper) or to increase their captive pulp production. Prices may still rise after actual pulp consumption by paper mills has begun to decline. At some point, buyers realize that more than enough pulp is available, and they begin to reduce their inventories. Prices start to weaken, and buyers hold off on making any purchases in anticipation of lower prices. The downward market spiral is under way, and it may not stop until prices approach the break-even level for the average North American/Nordic producer, which usually triggers widespread industry production curtailments.

Market pulp cycles are also loosely related to underlying demand and supply conditions and to the general economy. Demand for market pulp is affected by production levels for paper and paperboard, which in turn reflect general economic activity. But the pulp market has sometimes gone down when the economy is strong, or it stages a recovery when general business conditions are weak. Ross Hay-Roe, industry analyst, has noted that sometimes a two-year lag has occurred between turning points in the U.S. economy and changes in pulp prices.

Capital investment in the market pulp industry usually comes in surges during periods of rising prices and profitability. New mill construction usually takes two to three years. Once the wave of new capacity comes onstream, the market may weaken, resulting in oversupply and declining prices. As profitability declines, companies rein in capital spending, slowing down capacity expansion and setting the stage for the next period of market tightness.

Barometers used to gauge price changes include North American and Nordic producer inventories and operating rates for chemical paper-grade market pulp. Historically, market pulp prices tend to rise when ratios of shipments to capacity reach about 92% to 93% and when inventories of North American and Nordic producers drop to around 1.2 to 1.3 million tons. When operating rates decline below this level and inventories increase, prices usually (but not always) begin to weaken.

API's Slinn has noted that from about 1970 to 1982, a curiously consistent two-year-nine-month time span existed between peaks and troughs in North American and Nordic producer inventory levels. This made the entire cycle (from peak to peak or trough to trough) slightly more than five years. However, the pattern

SOURCES OF MARKET PULP CONSUMED IN THE U.S.

(000 tons)

Year	Domestic market pulp shipments	% of total	Market pulp imports	% of total	Total apparent consumption
1989	2,425	47%	2,726	53%	5,151
1988	2,623	48	2,891	52	5,514
1987	2,557	48	2,753	52	5,310
1986	2,507	49	2,610	51	5,117
1985	2,355	50	2,318	50	4,673
1984	2,411	50	2,418	50	4,829
1976	1,679	44	2,116	56	3,759
1970	1,503	44	1,882	56	3,385

Source: American Paper Institute.

broke in 1982 when, after only 19 months, a nine-week strike in British Columbia caused producer inventories to hit a low of 911,000 tons in March 1984. The next peak of 1.8 million tons came in February 1985 after only 11 months. Inventories reached a new low of 676,000 tons in December 1988—just over the two-year-nine-month historical pattern. This particular crystal ball, however, is a bit cloudy since inventories at the end of 1989 dropped to almost to the same level—673,000 tons. Based on this pattern, the next peak will be reached around September 1991—or September 1992.

In addition to labor negotiations (particularly in British Columbia), another external factor that can affect the pulp market is governmental policy. Producer inventories hit an all-time high of 2.9 million tons in February 1977 due to a Swedish government program to subsidize inventory building in order to keep employment levels high.

Exchange-rate fluctuations have also had a growing impact on pulp prices. Fluctuations in the value of the dollar upset comparative cost relationships among major producing regions, and they affect the price of pulp for buyers in terms of their local currencies. The rise of the dollar during the 1980-84 period dramatically increased the cost advantage of Scandinavian and nontraditional producers, thus enabling them to price pulp more competitively. At the same time, weak currencies increased the cost of dollar-priced pulp for buyers in Europe and other overseas markets and made them more resistant to pulp price increases. The dollar's decline since 1985 has dramatically improved the cost position of North American producers, and it made price increases easier for buyers in Europe and Japan to accept while strong market conditions persisted through the first half of 1989.

Under 1984 price-fixing settlements with the European Community, Nordic producers price their pulp in European currencies. Although this measure was intended to reduce the "transparency" of the market, local currency prices in fact tend to equalize with the dollar price of pulp. The ruling was designed to help European pulp buyers who were being "scissored" between expensive dollar-priced pulp and increasing shipments of Nordic white paper pulp priced in local currencies. Ironically, the dollar began to decline not long after the ruling was made.

The combination of volatile exchange rates and dual-

CANADIAN MARKET PULP SHIPMENTS BY GRADE

(000 metric tons)

			Total						
		Dissolving and special alpha	Chemical paper grade	Bleached sulfate (kraft)[2]		Un-bleached sulfate	Sulfite		
Year	All grades[1]			Softwood	Hardwood		Bleached	Unbleached	Mechanical
1989	8,164	268	6,969	5,682	919	98	254	16	923
1988	8,204	268	7,235	5,938	875	103	296	23	698
1987	8,084	243	7,259	5,947	862	117	309	24	579
1986	7,558	239	6,764	5,541	781	132	291	19	552
1985	6,745	216	6,058	4,929	733	154	225	17	469
1984	6,613	221	5,845	4,696	768	154	213	23	535
1983	6,795	210	6,219	5,082	731	188	184	34	365
1982	5,611	226	5,124	4,210	524	179	165	46	257
1981	6,498	270	6,024	4,886	593	225	249	71	199
1980	7,024	310	6,476	5,301	587	231	270	87	223
1979	6,683	371	6,312	5,448		262	284	84	234
1978	6,521	360	5,952	5,342		243	287	80	209
1977	5,742	268	5,325	4,643		291	336	55	149
1976	5,541	241	5,137	4,446		275	340	76	163
1975	4,671	206	4,325	3,655		316	293	61	140
1974	6,179	350	5,654	4,774		375	347	158	175
1973	5,677	252	5,252	4,468		425	272	87	173
1972	4,927	244	4,555	3,851		350	281	73	128
1971	4,238	272	3,859	3,185		254	307	113	107
1970	4,717	317	4,250	3,392		292	381	185	150
1965	3,036	300	2,542	1,565		206	512	259	194
1960	1,807	192	1,479	780		225	310	164	136
1955	1,800	324	1,234	384		222	367	321	182
1950	1,457	291	1,252	370		196	289	397	240

1. Includes screenings (about 3,000 tons in recent years.)
2. Includes semibleached.
Source: Canadian Pulp & Paper Assn.

currency pricing tends to "lubricate" the movement of prices upward in a tight market, and it will probably make them come down faster in a weak market, according to Ross Hay-Roe. During the tight 1986-88 pulp market, North American producers used any weakness in the dollar as an excuse to raise their dollar prices to the level of local currency prices in Europe. Likewise, any strengthening in the dollar during this period was used by Nordic producers as an excuse to raise their local currency prices to North American dollar price levels in Europe. The result was an almost continuous series of dollar and/or local currency price increases from 1986 to mid-1989.

RECENT MARKET CONDITIONS

The world pulp market peaked around mid-1989 and then began another cyclical decline that will probably extend through 1991. The price of NBSK pulp reached $840/metric ton c.i.f. in northern Europe in the second quarter of 1989—the last of 13 almost consecutive quarterly price increases during which time the dollar price more than doubled. But already in the second quarter, there were signs of difficulty when producers were unable to push through a hardwood pulp price—followed later in the year by reports of growing spot discounting on southern mixed hardwood.

The perception that pulp prices had finally peaked and were coming down caused pulp consumers in Europe and Japan to begin holding off on pulp purchases in fourth-quarter 1989. U.S. pulp producers went through a similar inventory adjustment earlier in 1989 in response to a downturn in white paper production caused by inventory liquidation at the printer/converter/distributor level. As a result, world shipments of chemical paper-grade pulp declined 1.6% to 26.3 million tons in 1989 from the previous year—the first such decline since 1982. Producer inventories at North American and Nordic mills began to rise sharply from a low of 673,000 tons reached at the end of 1988 to 1.03 million tons by the end of 1989.

The price of U.S. southern pine and mixed hardwood began to fall sharply during the first four or five months of 1990. The price of southern pine in Europe dropped from a list of $810 in fourth-quarter 1989 to about $650, while the price of southern mixed hardwood skidded from a list of $780 to about $600 by the spring of 1990. Many Canadian and Nordic producers, however, adopted a strategy of taking downtime to reduce inventories instead of dropping prices—rather than trying to compete with much lower-cost southern U.S. mills on price. "Why fight a war you can't win?" asked one Canadian pulp producer.

This created an unprecedented gap of more than $150 to $200/ton between the price of northern and southern softwood, while a smaller but unusually large gap opened be-

CANADIAN MARKET PULP CAPACITY

(000 metric tons)

Year	Total	Dissolving and special alpha	Sulfite bleached	Sulfite unbleached	Sulfate bleached softwood	Sulfate semibleached	Sulfate bleached hardwood	Sulfate unbleached	Mechanical
1992e	10,051	250	292	49	6,069	329	1,360	102	1,600
1991e	9,791	250	299	49	5,995	341	1,285	102	1,470
1990e	9,020	257	301	49	5,810	321	1,064	102	1,116
1989	8,817	281	302	41	5,714	316	969	104	1,090
1988	8,412	277	299	24	5,665	376	913	113	745
1987	8,179	245	307	24	5,533	473	873	125	599
1986	7,985	245	292	24	5,396	501	809	129	589
1985	7,769	266	270	35	5,233	420	794	177	574
1984	7,670	264	240	39	5,134	405	869	198	521
1983	7,641	201	250	72	5,130	453	780	208	500
1982	7,617	305	286	83	5,128	438	669	236	472
1981	7,430	303	313	84	5,056	433	634	290	317
1980	7,237	307	265	95	4,905	550	605	270	240
1979*	7,112	395	257	106	4,733	524	579	253	265
1978	7,381	424	354	187	4,739	537	590	297	253
1977	7,273	353	425	200	4,514	586	565	370	260
1976	7,224	408	527	202	4,306	562	621	339	259
1975	7,156	427	541	194	4,164	627	613	329	261
1974	6,955	404	472	192	3,976	742	594	354	221
1973	6,502	416	358	149	3,693	664	666	362	194

*Not comparable with previous years' data due to change in method for estimating capacity.
e = Estimate.
Source: Canadian Pulp & Paper Assn.

tween northern hardwood (and eucalyptus) and southern U.S. hardwood in the first half of 1990. Such a price gap did not go unnoticed by papermakers, who began to substitute more southern softwood and hardwood at the expense of northern pulp. The share of total North American and Nordic chemical paper-grade market pulp shipments from Canadian producers in the first half of 1990 declined to 35.8% compared with 38.2% for all of 1989.

Canadian mills for the first half of 1990 ran at only 86% of capacity, while operating rates for U.S. producers averaged 95%. In certain markets, such as Japan, customers shifted heavily to use of southern pine (and sharply reduced all hardwood pulp purchases due to domestic industry capacity expansion). The weakening dollar was another factor that helped Canadian producers keep the price of NBSK at $840 through the first half of 1990. Nordic producers, however, were forced to reduce their local currency prices in Europe for NBSK at the beginning of the year to DM1,400/metric ton c.i.f. from DM1,630 in the case of Germany.

By early July, the pressure had become too great and Canadian producers dropped their NBSK list price to $800/metric ton in Europe (c.i.f.) and the U.S. (delivered). Nordic producers then lowered their local currency prices—to DM1,250 in Germany. One positive development in the market by early summer was that U.S. southern softwood producers were sold out due to their attractive prices. Several large U.S. producers announced a $30/metric-ton price increase on southern pine to $680 for the third quarter—which was expected at least to help stabilize the market.

However, hardwood pulp prices continued to erode sharply through the fall of 1990. Southern mixed hardwood by the end of the third quarter was down to $500 to $530/metric ton in the U.S. market and was slipping to that level in Europe. Contract eucalyptus prices in the U.S. sank to $600/metric ton in the third quarter, while spot Iberian prices were down in the low-to-mid-$500 range in the U.S. and Asia. By the end of the third quarter, Northern hardwood pulp prices were down to the $550 to $600/metric-ton level in the U.S. and slightly higher in Europe.

North American and Nordic producer pulp inventories were up to 1.495 million tons by September 1990 despite

CANADIAN EXPORTS OF WOODPULP[1]

(000 metric tons)

Year	All grades[2]	Dissolving and special alpha	Sulfite bleached	Sulfite unbleached	Sulfate bleached hardwood	Sulfate bleached softwood[3]	Sulfate unbleached	Mechanical
1988	8,407	219	378	47	792	6,227	108	329
1987	8,241	213	395	40	591	6,358	112	312
1986	7,619	216	388	48	529	5,795	137	340
1985	7,025	174	292	49	507	5,391	152	360
1984	7,040	182	313	61	519	5,279	156	379
1983	6,823	177	283	50	477	5,321	166	314
1982	6,099	174	295	101	359	4,665	230	272
1981	6,744	221	424	86	429	5,026	281	270
1980	7,248	235	396	108	409	5,579	210	311
1979	7,090	241	482	104	341	5,358	248	317
1978	6,638	210	509	83	350	4,952	243	291
1977	6,092	130	564	81	341	4,404	295	276
1976	6,116	147	515	92	341	4,473	262	286
1975	5,001	125	414	82	285	3,565	331	189
1974	6,438	243	532	141	306	4,573	373	262
1973	5,939	208	385	107	381	4,148	448	253
1972	5,536	283	369	100	411	3,738	377	249
1971	5,149	316	387	115	392	3,375	342	210
1970	5,063	302	440	162	345	3,220	328	251
1965	3,495	349	570	239	1,703		333	284
1960	2,360	220	394	154	1,016		314	213
1955	2,146	299	415	337	608		201	23[illegible]
1950	1,675	263	243	374	356		172	225

n.a. = Not available.

1. Includes some pulp shipped to mills in the U.S. that have the same ownership. Such "tied" pulp, which totals about 1.0 million tons, is not included in market pulp shipments.

2. Total includes unspecified grades (not shown). Years 1950-60 include small amounts of soda pulp (not shown).

3. Includes semibleached sulfate exports (about 350,000 tons in recent years).

Source: *Statistics Canada.*

CHEMICAL PAPER-GRADE MARKET PULP CAPACITY OF MAJOR NORTH AMERICAN PRODUCERS

		Annual capacity* (000 metric tons)			**Capacity**
		U.S.	**Canada**	**Total**	**share (%)**
1.	Georgia-Pacific[1,2,5,6]	1,675	—	1,675	11.4%
2.	Weyerhaeuser[1,2,3,5,6]	960	600	1,560	10.6
3.	International Paper[1,2,6]	850	—	850	5.8
4.	Canadian Pacific[1,2,3,4]	—	800	800	5.5
5.	Fletcher Challenge[1,3,4]	—	705[a]	705	4.8
6.	Champion International[1,2,3]	245	450[b]	695	4.7
7.	Parsons & Whittemore[1,2]	430	230	660	4.5
8.	Noranda[1,2,3,5]	—	568[c]	568	3.9
9.	Canfor[1,3,4]	—	555[d]	555	3.8
10.	MacMillan Bloedel[1,3,4]	—	500	500	3.4
11.	Federal Paper Board[1,2]	490	—	490	3.3
12.	Stone Container[1,2,4]	220	265[e]	485	3.3
13.	Repap Enterprises[1,3,4]	—	480	480	3.3
14.	Daishowa Forest Products[1,2]	—	428[f]	428	2.9
15.	Procter & Gamble[1,6]	100	320	420	2.9
16.	ITT Rayonier[1,5,6]	355	—	355	2.4
17.	Simpson Paper[1]	338	—	338	2.3
18.	Boise Cascade[1,3,4]	280	50	330	2.2
19.	Louisiana-Pacific[1,5,6]	315	—	315	2.1
20.	Bowater[1,3]	310	—	310	2.1
21.	Western Forest Products[1,3,5,6]	—	260	260	1.8
22.	E.B. Eddy[1,2]	—	210	210	1.4
23.	Irving Pulp & Paper	—	200	200	1.4
24.	Crestbrook[1]	—	190	190	1.3
25.	Pope & Talbot[1]	180	—	180	1.2
26.	Donohue[1]	—	165[g]	165	1.1
27.	James River[1]	—	160	160	1.1
28.	Mead[1]	—	160	160	1.1
29.	Chesapeake[2]	145	—	145	1.0
30.	Willamette Industries[2]	140	—	140	1.0
31.	Stora Forest Industries[5]	—	135	135	0.9
32.	Potlatch[1]	130	—	130	0.9
33.	Domtar[1]	—	125	125	0.9
34.	Malette Kraft Pulp & Power[1]	—	125	125	0.9
35.	Temple-Inland[1]	110	—	110	0.7
36.	Port Townsend[4]	105	—	105	0.7

North American capacity (1990): 14.692 million metric tons
Capacity share of top five companies: 38.2%
Capacity share of top ten companies: 58.5%

Key to grades: 1—bleached softwood kraft; 2—bleached hardwood kraft; 3—semibleached softwood kraft; 4—unbleached softwood kraft; 5—bleached sulfite; 6—fluff pulp.

*Capacity share based on equity ownership (excluding less than 50%-owned affiliates, which in many cases appear as separate listings).

a. Includes 45% of Donohue St. Felicien (300,000 tpy).

b. Includes 84.6% of Weldwood of Canada, which has a 50% stake in Cariboo Pulp & Paper (330,000 tpy).

c. Includes 100% of Fraser and James Maclaren Industries and 50% of Northwood Pulp & Timber (excludes 48%-owned MacMillan Bloedel, which is shown separately).

d. Includes 50% of expanded Howe Sound Pulp (330,000).

e. Includes 25% of Celgar Pulp (190,000 tpy), which is owned 25% by Power Corp. and 50% by a Chinese government agency.

f. Includes 25% of Cariboo Pulp.

g. Includes 55% of Donohue St. Felicien.

h. Includes 50% of Northwood Pulp (515,000 tpy of which about 300,000 tpy is market pulp).

heavy downtime taken through the year by Canadian and Nordic mills. Total North American and Nordic shipments of chemical paper-grade market pulp for the first nine months of the year were down 8.5%. While shipments by Canadian mills were off 15.6%, shipments by U.S. mills were 1.3% higher than in the same period of 1989. Pulp consumers in most major markets had probably reduced inventories to below-normal levels, but there was a pickup in orders for northern pulp.

As a result, Canadian producers on Nov. 1, 1990, reduced their price for NBSK to $750 in Europe and the U.S. In response, Nordic producers reduced their local currency prices in Europe for NBSK—to DM1,150/ton in Germany. The local currency price for NBSK had dropped nearly 30% from its peak due to the combined effected of the reductions in the dollar price of pulp along with the decline in value of the U.S. dollar. The dollar price was down about 11%.

MARKET OUTLOOK

High pulp price levels and attractive return on investment during the 1987-89 period stimulated a wave of market pulp expansion activity. During the 1989-95 period, world paper-grade market pulp capacity (including mechanical grades) may expand from 30.9 million metric tpy to 39.4 million tpy by 1995—an increase of 8.5 million metric tons, CPPA's McCaffrey told a Paper Industry Management Assn. conference in the spring of 1990. This would represent an average annual rate of capacity growth of 4.2%/year over this period, compared with a 2.6%/year rate of growth over the 1980-89 period.

If pulp shipments continued to rise at about 2.7%/year (about the average for the past decade), world demand would reach about 32.5 million tons by 1995. As a result, there would be close to 7 million tons of surplus pulp, and operating rates would drop to the low-80% range by the early 1990s. Fortunately, the recent market downturn and environmental obstacles will cause the cancellation or postponement of some new projects. In addition, some market pulp mills may be integrated with paper machines so that the total capacity growth will probably be slower.

Nevertheless, even under the most optimistic scenarios there will be a significant oversupply of pulp during the first half of the 1990s. The biggest bulge in new capacity is expected to occur in 1991, with 1.9 million tons of new capacity coming online, followed by another 2.5 million tons in 1992-93. A substantial part of the 2.9 million tons of new capacity originally planned for 1994-95, however, will probably be delayed or cancelled. As a result, some analysts see world operating rates for paper-grade pulp mills averaging 86% to 87% over the 1990-91 period and then improving to the low-90% range by 1992-94. Shipments should begin to rebound in 1992, reflecting stronger economic growth and rebuilding of customer inventories.

If the history of past cycles is repeated, pulp prices will

OPERATING RATES FOR NORTH AMERICAN AND SCANDINAVIAN PAPER-GRADE MARKET PULP MILLS

Year	U.S.	Canada	Sweden	Finland	Norway	Total
1989	96%	95%	96%	98%	96%	96%
1988	96	98	96	100	84	97
1987	100	98	90	96	100	97
1986	95	92	84	89	91	91
1985	86	86	81	84	89	86
1984	94	86	93	90	94	89
1983	89	88	87	82	90	85
1982	85	77	68	72	86	77
1981	90	89	79	89	83	97
1980	95	99	90	95	84	93
1979	88	93	82	94	n.a.	90
1978	92	83	70	71	n.a.	80
1977	87	80	62	58	n.a.	74

n.a. = Not available.
Source: Trade associations.

CHEMICAL PAPER-GRADE PULP SHIPMENTS BY NORTH AMERICAN AND SCANDINAVIAN PRODUCERS

(000 metric tons)

Year	U.S.	Canada	Sweden	Finland	Norway	Total	Brazil
1989	6,487	6,969	2,730	1,748	312	18,246	—
1988	6,498	7,235	2,894	1,784	311	18,722	—
1987	6,227	7,260	2,864	1,770	342	18,461	1,359
1986	5,912	6,674	2,803	1,603	326	17,407	1,216
1985	5,183	6,058	3,036	1,632	299	16,208	1,256
1984	4,970	5,854	3,351	1,680	304	16,475	1,298
1983	4,816	6,219	3,122	1,743	202	16,102	1,259
1982	4,172	5,131	2,487	1,565	120	13,475	1,100
1981	4,248	6,024	2,816	1,839	134	15,061	1,060
1980	4,342	6,481	2,877	2,057	75	15,832	1,184
1979	3,781	6,078	3,335	2,030	112	15,336	765
1978	3,378	5,953	3,714	1,687	129	14,861	212
1977	3,030	5,327	3,167	1,304	172	13,000	55

Source: North American and Nordic trade associations.

probably continue to erode in 1991-92 until prices drop below the variable-cost level of higher-cost producers in Canada and the Nordic countries (see cost section ahead). This would indicate that the price of NBSK pulp could drop below $600/metric ton and hardwood pulp could decline to around $400/ton. This would then cause the higher-cost mills to curtail or integrate production and result in a rebalancing of the market.

However, this "classical" model may not be completely predictive, and pulp prices may drop further for the following reasons: 1) many market pulp mills are integrated with paper machines, which changes the economics of the entire facility; 2) lenders may take control of mills in a downturn and their main objective is recovering their investment and not profitability; and 3) sellers hate to lose customers and always think the downturn will be short in duration, according to one pulp marketing executive.

The price gap between NBSK pulp and shorter fiber pulps may be expanding. As noted earlier, in the current market downturn the price gap between northern softwood and pine has expanded from $30 to more than $100/ton, and the gap with southern hardwood has widened from about $50 to more than $200/ton. These differentials will probably narrow as the market begins to bottom out but will remain larger than normal for the following reasons: 1) NBSK capacity is expected to increase at only about a 2.1%/year rate over the next five years vs a higher rate for pine and hardwood; 2) production costs of northern mills based on a limited supply of softwood fiber will be much higher than those for southern mills based on large, fast-growing plantations of pine and eucalyptus; and 3) hardwood pulp will be facing the most direct competition from the new BCTMP and deinked market pulps.

NEW WAVE OF CAPACITY EXPANSION

World capacity for bleached softwood kraft pulp is expected to rise from 14.2 million tons in 1989 to 18.4 million tons by 1995—an increase of 29.5%, according to McCaffrey. However, bleached hardwood kraft pulp capacity is expected to jump from 10.4 million tons to 14.1 million tons in 1995—an increase of 35.6%. The other major category that will show a significant increase is mechanical pulp, which is expected to rise from 2.6 to 3.5 million tons. Sulfite pulp will remain relatively flat at 1.9 million tons, while unbleached kraft pulp capacity declines from 1.7 to 1.5 million tpy due to plans to add bleaching capacity at some mills.

Canada will be adding about 2.6 million tons of new paper pulp capacity over the 1989-95 period. About 2.2 million tons will be bleached softwood kraft, while another 750,000 tons each will come from bleached hardwood kraft and BCTMP. Canadian market pulp capacity is expected to reach 11 million tons by 1995. Daishowa Forest Products Ltd. started up its new 340,000-tpy bleached kraft hardwood/softwood mill in Peace River, Alta., in mid-1990. And three new BCTMP mills (Donohue Matane Inc., Louisiana-Pacific Corp., and Alberta Energy) with a combined capacity of about 450,000 tons will start up in 1990-91. However, the proposed 190,000-tpy expansion of Celgar Pulp Co. in Castlegar, B.C., still has not begun, and the 500,000-tpy Alberta Pacific Forest Industries mill in Alberta has been facing significant environmental opposition.

The U.S. will remain the second largest market pulp producer with plans to add 1.7 million tons of capacity, bringing its total up to 8.6 million tons. Weyerhaeuser Co. in mid-1990 started up its new 425,000-tpy bleached softwood kraft pulp line at Columbus, Miss. Stone Savannah River and Union Camp Corp. will be bringing on new pulp lines at existing mills in 1991. Alabama River (Parsons & Whittemore Inc.) is scheduled to start up its new 450,000-tpy bleached softwood kraft pulp mill at Claiborne, Ala., in 1992. Two major pulp projects (Pope & Talbott Inc. and WTD) in Oregon, however, are indefinitely postponed.

About 1.3 million tons of new pulp capacity over the 1989-95 period has been announced for the Nordic countries. This includes several large projects in Finland, which may be partly integrated. One of the most interesting is Enso Gutzeit Oy's joint venture with the Soviet Union to expand its Uimaharju mill by 350,000 tpy. Western Europe

NORTH AMERICAN AND SCANDINAVIAN CHEMICAL PAPER-GRADE PULP SHIPMENTS BY MAJOR WORLD MARKETS

(000 metric tons)

Year	U.S.	Western Europe[1]	Japan	Nordic countries	To other countries	Total
1989	4,788	7,015	2,108	995	3,340	18,246
1988	5,122	6,916	1,941	996	3,656	18,722
1987	4,953	6,686	1,755	1,095	3,974	18,461
1986	4,831	6,563	1,618	1,018	3,349	17,407
1985	4,466	6,157	1,353	933	3,299	16,208
1984	4,682	6,181	1,241	969	2,975	16,408
1983	4,603	6,457	1,207	951	3,201	16,102
1982	3,811	5,551	980	773	2,360	13,475
1981	4,197	6,409	947	897	2,611	15,061
1980	4,327	6,536	1,244	991	2,734	15,832
1979	4,493	6,587	1,017	993	2,246	15,336
1978	4,193	6,520	973	878	2,297	14,861
1977	3,838	5,653	689	733	2,087	13,000

1. Including U.K.

Sources: North American and Nordic trade associations.

will be adding only about 235,000 tons of net capacity, with a higher level of market pulp expansion activity being offset by integration projects at some mills. Stora's Celbi mill in northern Portugal will be expanding bleached eucalyptus capacity from 240,000 to 600,000 tpy by the second half of 1992.

In Latin American, capacity is expected to increase by about 2 million tons over the six-year period, reaching about 4.8 million tons by 1995, according to McCaffrey. Most of the expansion will be in Brazil and Chile, where about 1.3 million tpy of eucalyptus and 750,000 tpy of radiata pine will be added. Celulosa Santa Fe (backed by Scott Paper Co., Shell, and Citibank) is building a 235,000-tpy eucalyptus mill at Nacimiento for completion in early 1991. Celulosa Pacifica, a joint venture between Simpson Paper Co. and Cia. Manufacturera de Papeles y Cartones SA (CMPC), is building a 315,000-tpy bleached kraft mill in Renaico, and Celulosa Arauco y Constitucion SA is planning a 350,000-tpy expansion of its Arauco mill. Both softwood projects are scheduled for completion in 1992.

In Brazil, Aracruz Celulose SA will add 525,000 tpy to double the size of its existing eucalyptus mill to more than 1 million tpy by early 1991. Cenibra is moving ahead with its plans to add 350,000 tpy of capacity to its Belo Oriente mill by 1993. Norcell, a joint venture of Riocell and Compene, plans to build a 420,000-tpy mill at Bahia for completion in 1994. And Riocell also plans to add 310,000 tpy of capacity at its existing Guiaba mill by 1995. In Argentina, Puerto Piray is scheduled to finally complete a 230,000-tpy pulp expansion in 1992, and additional projects are under study.

COMPARATIVE PRODUCTION COSTS

The decline of the dollar since the mid-1980s has caused a significant shift in comparative manufacturing cost advantage among the major traditional market pulp producing regions of the world. The U.S. South in particular has developed a significant cost advantage over competitors in Canada and Scandinavia, which have also been hurt by a higher level of cost inflation, according to the latest study prepared by Price Waterhouse for the Forest Sector Advisory Council (FSAC), a Canadian government/industry group.

Here are the estimated 1988 delivered costs (excluding interest and depreciation and converted into U.S. dollars) for the various regions: U.S. South, $336/metric ton; U.S. West Coast, $382; British Columbia Coast, $433; eastern Canada, $434; British Columbia interior, $452; Sweden, $496; and Finland, $498. The British Columbia coast improved its position to third place in 1988 from fifth place the previous year, while the British Columbia interior dropped to fifth place from third place in 1987. All other regions remained the same in the rankings.

The competitive position of the U.S. South has been helped by the weak dollar combined with excellent cost control by mills in the region, according to the study. Delivered costs per ton rose 7% in the region in 1988 from the previous year but have declined 9% since 1983 (partly due to higher capacity utilization). The U.S. West has also significantly improved its competitive position since 1983, although in 1988-89 it began to experience more cost pressure from rising woodchip costs partly due to declining timber supply.

NORTH AMERICAN AND SCANDINAVIAN PRODUCER INVENTORIES OF CHEMICAL PAPER-GRADE MARKET PULP

(000 metric tons)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1990*	1,422	1,475	1,392	1,388	1,442	1,397	1,699	1,682	—	—	—	—
1989*	890	897	763	804	841	785	945	1,033	992	1,068	1,182	1,026
1988	915	900	797	815	767	671	798	845	772	797	852	673
1987	1,000	1,022	867	907	925	801	955	1,053	854	870	897	676
1986	1,330	1,306	1,131	1,024	1,080	943	1,014	1,030	894	890	1,018	847
1985	1,788	1,836	1,790	1,643	1,466	1,478	1,504	1,528	1,384	1,504	1,562	1,326
1984	1,303	1,084	914	1,003	1,034	1,039	1,247	1,349	1,309	1,490	1,635	1,616
1983	1,698	1,746	1,570	1,531	1,523	1,435	1,599	1,624	1,475	1,503	1,630	1,207
1982	1,579	1,690	1,767	1,744	1,840	1,878	1,876	1,923	1,748	1,840	1,809	1,603
1981	1,097	1,194	1,209	1,193	1,185	1,026	1,116	1,195	1,146	1,373	1,573	1,430
1980	745	741	747	754	801	745	813	916	830	933	1,094	949
1979	938	1,006	960	865	809	737	759	790	734	713	723	616
1978	2,119	2,016	1,857	1,776	1,612	1,288	1,188	1,193	1,069	1,046	1,038	903
1977	2,891	2,920	2,888	2,760	2,810	2,789	2,822	2,865	2,776	2,656	2,577	2,083
1976	2,121	2,260	2,373	2,408	2,474	2,588	2,638	2,749	2,720	2,809	2,882	2,824
1975	860	1,016	1,326	1,464	1,754	1,858	1,980	2,101	2,049	2,091	2,163	2,013
1974	628	628	625	595	565	532	545	557	538	550	567	611

*Preliminary.
Source: North American and Nordic trade associations.

The British Columbia interior experienced a 12% increase in delivered costs in 1988, the largest increase (in local currency) for any region. The main reason has been rising woodchip costs. Until mid-1988, chip prices in the British Columbia interior were directly linked to rising pulp prices, and then in mid-1988, a minimum price was set at a higher level than provided by the previous formula. The British Columbia coast appears to have improved its position due to modernization of some mills and lower energy and delivery costs.

During the 1983-85 period, Sweden and Finland ranked lowest in delivered costs among the seven producing regions. The dramatic shift in the competitive position of these countries over the past six years reflects the decline of the Canadian and U.S. dollars again the Nordic currencies. Another factor hurting Sweden has been a 25% increase in delivered costs (in its own currency) mainly due to higher fiber and labor costs, according to the study.

Fiber costs in Sweden and Finland in 1988 were the highest for any region—more than twice those in the U.S. and British Columbia and about 50% more than in eastern Canada. However, energy and labor costs are the lowest in Finland. In Sweden, part of this increase may be attributed to the wood lot system prevailing in that country, according to FSAC. "Swedish wood lot owners are subjected to very high rates of tax on the sale of timber, leaving them with no

COMPARATIVE NORTH AMERICAN AND NORDIC REGIONAL MANUFACTURING COSTS FOR BLEACHED SOFTWOOD KRAFT MARKET PULP IN 1988

(US$/metric ton)

	British Columbia		Eastern	U.S.	U.S.		
	Coast	Interior	Canada	West	South	Finland	Sweden
Wood fiber	$150	$141	$184	$123	$110	$315	$301
Chemicals	41	52	47	45	57	51	32
Energy	26	24	18	33	16	3	7
Labor	88	69	63	53	55	41	66
Other[1]	63	77	49	54	41	36	36
Mill level costs	368	363	361	308	279	446	442
Corporate and sales expense	19	15	19	7	10	10	10
Delivery	46	74	54	67	47	42	44
Total delivered cost[2]	433	452	434	382	336	498	496

1. Includes materials, maintenance services, and mill administration net of byproduct revenues.
2. Before depreciation and interest expense.
Source: Forest Sector Advisory Council, "The Market Pulp Industry 1984-88."

HISTORICAL TOTAL DELIVERED MANUFACTURING COST FOR BLEACHED SOFTWOOD KRAFT AND COMPARATIVE RANKING AMONG REGIONS[1]

(Rank in parentheses)
(US$/metric ton)

	British Columbia		Eastern	U.S.	U.S.		
Year	Coast	Interior	Canada	West	South	Finland	Sweden
1990e[2]	$480 (3)	$510 (5)	$490 (4)	$430 (2)	$375 (1)	$590 (7)	$560 (6)
1988	433 (3)	452 (5)	434 (4)	382 (2)	336 (1)	498 (7)	496 (6)
1987	385 (5)	376 (3)	382 (4)	360 (2)	315 (1)	469 (6)	469 (6)
1986	354 (3)	344 (2)	354 (4)	372 (5)	325 (1)	408 (7)	406 (6)
1985	386 (7)	354 (3)	374 (5)	377 (6)	361 (4)	349 (2)	330 (1)
1984	427 (7)	405 (6)	376 (3)	382 (4)	385 (5)	341 (2)	314 (1)
1983	411 (7)	393 (5)	388 (4)	393 (5)	368 (3)	355 (2)	319 (1)

1. Before depreciation and interest expense. (Depreciation costs ranged from $52 in the U.S. South to $15 to $20 in Canada due to differences in accounting practices.)
2. *Pulp & Paper Week* estimate based on August 1990 exchange rates (US$ = C$1.16; Skr5.81; Fmk3.73) and assuming some cost inflation.
Source: Forest Sector Advisory Council, "The Market Pulp Industry 1984-88."

incentive to harvest their holdings," the study noted.

There were also substantial differences in energy costs among regions primarily because of the level of energy self-sufficiency and extent of cogeneration, according to the study. Energy costs were almost nil in Finland, where mills produce about 95% of all energy requirements and are heavily involved in cogeneration. The gap in energy costs between Finland and other regions narrowed over the period of the study, with oil prices dropping from almost $30/barrel in 1983 to $16 in 1988.

Labor costs in Finland in 1988 continued to be lower than for North American mills because total hours worked per ton amounted to 2.2 hours, the lowest of all regions. Delivery costs remained the highest in the British Columbia interior, reflecting the need for inland shipment to coastal ports or the use of rail transportation.

Capital investments on a per-ton basis were the highest in the U.S. West, Finland, and the British Columbia coast over the 1983-88 period and were the lowest in eastern Canada. Average age of construction of pulping facilities was newest in the South (1982), Finland, and Sweden (1980-81) but older for the Canadian industry (1973-75). However, the average age of facilities on the British Columbia coast has improved substantially in recent years.

The competitive position of U.S. producers has continued to improve against producers in Canada and the Nordic countries since the end of the FSAC study in 1988. After strengthening against the Nordic currencies in 1989 but not against the Canadian dollar, the U.S. dollar has recently gone into another sinking spell (partly due to the Middle East crisis). Meanwhile, fiber costs have begun to ease after jumping sharply in 1989 in such regions as the U.S. West Coast, British Columbia interior, and British Columbia coast. Energy and delivery costs are starting to take off again.

The following are some rough estimates of average delivered costs in 1990-based exchange rates in effect in late summer: U.S. South, $370; U.S. West, $430; British Columbia coast, $480; eastern Canada $490; British Columbia interior, $510; Sweden, $560; Finland, $600. These estimates are highly tentative since exchange rates, oil prices, and the world economy are in a state of flux (also partly due to the Middle East crisis). In addition, there have been rumors that the Nordic countries may devalue their currencies (as they did in October 1982). However, Sweden is a member of the European Currency System (informally known as the "Snake") and may have to keep its currency within a narrowly defined band of Euro-currencies.

MECHANICAL PULPS

Mechanical pulps are produced by either the groundwood, refiner mechanical, or thermomechanical pulping processes. A newer process, CTMP, is replacing the earlier processes for producing mechanical market pulp. The first CTMP mill was built in Sweden in the late 1970s, but the most dramatic growth for this process has occurred in Canada because of favorable wood and energy costs, government financial incentives, and willing entrepreneurs.

Since Quesnel River Co. started up the first CTMP mill in British Columbia in 1982, Canadian CTMP capacity has rocketed to about 900,000 tpy in 1989. Tembec Inc. (Temcell) brought on a new 100,000-tpy line at its Temiscaming, Que., mill in 1986. This was followed by three new mills in 1988: Cascades Inc.'s 210,000-tpy mill at Port Cartier, Que. (formerly a dissolving pulp mill); Millar Western Pulp Ltd.'s 210,000-tpy mill at Whitecourt, Alta.; and Fibreco Export Inc.'s 180,000-tpy mill at Taylor, B.C. Stone-Consolidated Inc. is also producing some unbleached market CTMP at its Bathurst, N.B., mill.

Acceptance of the new CTMP pulp in North America, particularly for use in printing/writing paper grades, however, has been slow to develop. Another round of new CTMP capacity will be hitting the market, though, with the late-1990 startup of Donohue Matane's 190,000-tpy softwood-based mill in Matane, Que., and Slave Lake Pulp Corp.'s 110,000-tpy aspen mill in northern Alberta. This will be followed by startup of Louisiana-Pacific's 160,000-tpy aspen-based mill at Chetwynd, B.C., in first-quarter 1991. And more capacity will be coming later in 1991 with the summer startup of Temcell Inc.'s second 150,000-tpy softwood/aspen CTMP line at Temiscaming. Then, Millar Western Inc.'s new 240,000-tpy two-line aspen mill at Meadow

WORLD DEMAND FOR CHEMICAL PAPER-GRADE MARKET PULP

(000 tons)

Year	Total world demand	From North American/Nordic countries	From nontraditional countries	% from North American/Nordic countries
1989	26,285	18,260	8,025	69.5%
1988	26,720	18,705	8,015	70.1
1987	26,395	18,465	7,930	70.0
1986	25,150	17,405	7,745	69.2
1985	23,450	16,095	7,355	68.6
1984	22,515	15,900	6,615	70.6
1983	22,320	15,895	6,425	71.2
1982	18,985	13,335	5,650	70.2
1981	19,970	14,490	5,480	72.6
1980	21,420	15,780	5,640	73.7
1979	20,505	15,310	5,195	74.7
1978	19,400	14,805	4,595	76.3
1977	17,060	12,995	4,065	76.2
1976	17,075	12,610	4,465	73.9
1975	14,900	11,290	3,610	75.8

1989 WOODPULP EXPORTS FROM MAJOR PRODUCING COUNTRIES

(000 tons)

	Exporters					
Major importers	**Canada**	**U.S.**	**Sweden**	**Finland**	**Norway**	**Brazil**
Austria	48	29	62	43	5	9
Belgium	235	50	155	28	18	43
Bulgaria	—	—	—	5	—	—
Czechoslovakia	—	—	21	25	—	—
Denmark	—	2	55	15	18	6
Finland	9	2	24	—	8	—
France	263	276	295	155	71	58
German Dem. Rep.	6	—	27	46	8	7
Germany, Fed. Rep.	714	548	809	438	121	75
Greece	21	28	23	27	8	—
Hungary	—	—	15	3	5	—
Ireland	16	1	2	4	—	—
Italy	468	409	334	105	46	39
Netherlands	132	129	174	69	42	12
Norway	—	—	77	1	—	—
Poland	4	9	18	8	8	—
Portugal	1	4	7	10	—	—
Spain	41	94	70	9	6	4
Sweden	20	15	—	15	54	14
Switzerland	55	32	69	49	10	4
U.K.	368	248	323	273	79	68
U.S.S.R.	30	28	—	103	81	—
Yugoslavia	10	11	30	2	1	2
Other Europe	2	3	13	2	18	3
Total Europe	2,441	1,918	2,603	1,436	607	343
Canada	—	157	1	—	—	9
U.S.	3,675	—	37	14	—	275
Total North America	3,675	157	38	14	—	284
Australia	93	27	11	22	—	5
China, People's Rep.	123	91	18	11	—	3
Hong Kong	14	10	—	—	—	—
India	71	33	11	9	8	—
Indonesia	63	69	12	9	—	1
Iran	—	—	1	—	—	—
Iraq	—	57	1	—	—	—
Israel	9	29	11	20	—	—
Japan	1,279	1,213	82	55	1	201
Korea, People's Rep.	1	—	—	—	—	—
Korea, Rep.	203	474	10	9	—	17
Malaysia	8	—	—	—	—	3
Philippines	8	—	—	—	—	—
Singapore	3	—	—	—	—	—
Taiwan	114	199	25	14	4	7
Thailand	33	18	5	4	—	—
Turkey	3	23	26	8	—	—
Other Asia/Australasia	1	74	17	6	6	4
Total Asia/Australasia	2,024	2,317	230	169	19	240
Argentina	4	2	—	—	—	4
Brazil	20	—	—	—	—	—
Colombia	1	7	—	1	—	6
Dominican Republic	2	—	—	—	—	—
El Salvador	1	—	—	—	—	—
Mexico	32	237	—	—	—	8
Peru	—	—	—	—	—	2
Puerto Rico	2	—	—	—	—	—
Venezuela	40	62	—	—	—	2
Other Latin America	3	27	2	—	—	1
Total Latin America	105	335	2	1	—	23
Algeria	1	41	3	6	—	—
Egypt	1	32	4	1	—	—
Morocco	—	1	17	1	—	—
South Africa	—	15	—	—	—	—
Zimbabwe	—	—	—	2	—	—
Other Africa	1	—	16	3	8	—
Total Africa	3	89	40	13	8	—
WORLD TOTAL	8,248	4,816	2,913	1,633	634	891

Source: *Pulp & Paper International*, Annual Review, July 1990.

Lake, Sask., will be coming onstream in early 1992.

All of this new capacity is hitting the market during a time of weakening pulp prices and before all the production from the industry's last round of BCTMP expansion has found market niches. This raises the prospect of difficult times for some producers—and possibly even an industry shakeout, which would probably result in the integration of some pulp mills with paper machines. Some new CTMP market pulp projects have been shelved, such as Cascades' plan to build a 115,000-tpy mill in Cabano, Que. And the Fibreco mill, which has experienced operational difficulties, recently changed ownership.

"The mills that have done and will continue to do best are the ones with committed end users," according to Gordon Floe of NLK Celpap. Millar Western, for example, is a major supplier to Scott Paper Co., while Quesnel River Pulp has been a long-term supplier to Procter & Gamble Co. Tembec's new BCTMP line (Temcell) will be partly integrated to its new (Temboard) bleached board machine (which will be taking about 70,000 tpy of the BCTMP output). Slave Lake is owned 75% by Alberta Energy and 25% by MoDo of Sweden, with the experienced Swedish company marketing all of its output.

The main attraction of the CTMP process for potential market pulp producers is its lower capital costs and wood consumption. A new greenfield bleached CTMP mill can be built for less than half the cost of a new kraft market pulp mill (on a per-daily-ton basis), and a ton of CTMP can be produced with less than half the wood required to make a ton of bleached softwood kraft pulp. Because of its lower manufacturing costs, CTMP producers have tried to sell their pulp at about 75% to 80% of the price of NBSK.

The first CTMP mills produced mainly higher-freeness softwood pulps that were used in tissue/towel applications. The newer mills are focusing on lower-freeness pulp, particularly aspen, for use in printing/writing papers—the largest potential end-use market. The new aspen CTMP can be bleached to between 85 and 87 ISO, while spruce pulps can be bleached to between 80 and 82. These levels are close to bleached kraft pulp, and they are adequate for many paper grades, particularly if coatings and fillers are used (which can also improve the economics of using CTMP fiber). Although lower in tensile and tear strength than kraft pulp, CTMP is superior in bulk and opacity and has good absorbency.

MAJOR MARKET PULP PRODUCERS OUTSIDE NORTH AMERICA*

(000 metric tpy)

Company	Capacity
Stora (Sweden)	1,160
Södra Skogsägarna (Sweden)	960
Fletcher Challenge (New Zealand)	780[1]
Mo och Domsjö (Sweden)	675
Portucel (Portugal)	650
Aracruz (Brazil)	525[2]
Sappi (South Africa)	450
ENCE (Spain)	440
Cel. du Rhone et d'Aquitane (France)	435
Veitsiluoto (Finland)	405
Soporcel (Portugal)	380
Cel. Arauco y Constitución (Chile)	370
Svenska Cellulosa (Sweden)	360

*Approximate capacities (includes fluff and mechanical pulp grades).

[1] Includes Canadian mills on equity basis (72% of Fletcher Challenge Canada).

[2] Capacity will rise to 1.05 million tpy in 1991.

WORLD MARKET PULP SHIPMENTS BY GRADE

(000 metric tons)

Year	Chemical paper-grade	Bleached softwood sulfate	Bleached hardwood sulfate	Unbleached sulfate	Bleached sulfite	Unbleached sulfite	Mechanical	Total
1989	26,285	13,275	9,810	1,530	1,575	95	2,130	28,415
1988	26,720	13,500	9,695	1,655	1,740	130	2,030	28,750
1987	26,395	13,375	9,340	1,745	1,795	140	1,785	28,180
1986	25,150	12,800	8,790	1,675	1,755	130	1,700	26,850
1985	23,450	11,795	8,085	1,650	1,760	160	1,625	25,075
1984	22,515	11,210	7,790	1,605	1,700	210	1,640	24,155
1983	22,320	11,130	7,485	1,815	1,695	195	1,450	23,770
1982	18,985	9,535	6,230	1,715	1,300	205	1,280	29,265
1981	20,470	10,380	6,245	1,845	1,710	290	n.a.	n.a.
1980	21,420	10,680	6,370	2,025	1,935	410	n.a.	n.a.

n.a. = Not available.

Source: Canadian Pulp & Paper Assn.

The biggest success for market CTMP pulp in North America has been in tissue/towel grades. Scott Paper Co., for example, is estimated to be using more than 100,000 tpy of CTMP in its tissue operations, and its worldwide consumption may soon be closer to 200,000 tpy, according to one estimate. The company is building a 105,000-tpy CTMP line at its Crabtree, Que., tissue mill, which will be mainly for internal use. P&G has also been a major user of CTMP, and Kimberly-Clark Corp. has been showing interest in the pulp.

But the North American printing/writing market for bleached market CTMP has been slow to develop, despite potential use in such grades as book papers, forms papers, and uncoated bond. Less than 100,000 tpy of CTMP was probably consumed in U.S. printing/writing grades last year. Use of CTMP in printing/writing papers has made more progress in Europe and particularly in such Asian countries as Rep. Korea and Taiwan.

One obstacle to CTMP's acceptance in the U.S. has been established printing/writing paper grade classifications that limit mechanical pulp content to 10% in free-sheet grades. Such classifications exist because of potential brightness reversion in mechanical pulps, although the amount of such loss in CTMP-containing papers might be acceptable for many applications. CTMP use has also been held back by lengthy trials at paper mills, the need for paper mills to install equipment and change procedures to handle the new pulp, and the problem of selling scrap paper that has some mechanical fiber content. "The attitude of many paper mills is, Why bother?— particularly when bleached kraft pulp prices are dropping," according to one consultant.

WORLD CHEMICAL PAPER-GRADE MARKET PULP CAPACITY[1]

(000 metric tons)

	1988	1989	1990e	1991e
Canada	7,390	7,430	7,590	7,910
U.S.	6,770	6,825	7,050	7,245
Norway	350	360	360	360
Finland	1,815	1,820	1,820	1,850
Sweden	2,990	2,920	3,030	3,005
North America/Nordic	19,315	19,355	19,850	20,370
Austria	390	390	390	390
Belgium	225	235	240	240
France	935	975	1,030	1,065
Fed. Rep. Germany	130	130	130	130
Italy	50	50	50	50
Portugal	1,260	1,295	1,300	1,340
Spain	725	730	750	760
Switzerland	125	125	125	125
Western Europe	3,840	3,930	4,015	4,100
Argentina	235	275	280	280
Brazil	1,465	1,580	1,645	1,915
Chile	555	575	595	695
Mexico	205	205	205	40
Latin America	2,460	2,635	2,725	2,930
Japan	715	715	715	715
Australia	35	25	25	25
New Zealand	285	275	305	305
Oceania	320	300	330	330
Indonesia	15	100	190	235
Morocco	105	105	115	130
South Africa	160	160	160	160
Rep. Korea	155	150	150	190
Swaziland	170	170	180	200
Taiwan	285	320	335	335
Asia/Africa	890	1,005	1,130	1,250
Total world[2]	27,540	27,940	28,765	29,695

e = Estimate.

1. Practical maximum: 100% of nominal capacity for North America, Nordic, Latin America; 97% for western Europe; 95% for Oceania, Asia, Africa; and 90% for Japan.

2. Excludes eastern Europe and People's Rep. China.

Source: North American and Nordic pulp and paper associations.

There was also hope that BCTMP might take off as a fluff pulp in Europe, where there was strong concern about the use of chlorine-bleached kraft fluff in diapers and other sanitary products. But this market failed to develop last fall after P&G began to aggressively market "chlorine-free" diapers using oxygen-bleached pulp. P&G was reportedly able to gain market share in many European countries, causing a shakeout among smaller French and U.K. diaper converters that had been using CTMP.

Some estimates place the European market for fluff CTMP at around 200,000 tpy. SCA's Mölnlycke group in Europe continues to be a major user of CTMP fluff. CTMP fluff does not have much potential in North America as long as such major diaper producers as P&G and K-C remain committed to kraft fluff pulp. One casualty from the failure of this market to develop has been Cascades' Port Cartier, Que., mill, which in 1990 was running at only half its full capacity and losing money. Port Cartier and Metsä-Serla's Lielahti mill in Finland are the only two CTMP mills that are fully equipped with pulp dryers to produce fluff pulp in the roll form preferred by most diaper converters.

According to CPPA statistics, Canadian shipments of mechanical market pulp through July were running at an annual-

MAJOR WORLD CHEMICAL PAPER-GRADE MARKET PULP EXPANSIONS

Company	Location	Capacity (000 metric tpy)	Startup date
CANADA			
Champion (Weldwood)	Hinton, Alta.	110 BSK	1990
James Maclaren	Thurso, Que.	70 BHK	1990
Canadian Pacific Forest Products	Dryden, Ont.	(110 BSK)	1990
Daishowa Forest Products	Peace River, Alta.	340 BHK/BSK**	1990
Howe Sound Pulp (Canfor/Oji)	Port Mellon, B.C.	100 BSK	1990
Fletcher	Three B.C. mills	105 BSK	1991
James River	Marathon, Ont.	175 BSK	1992
Malette Kraft Pulp & Paper	Smooth Rock, Ont.	70 BSK/BHK	1992
Repap Enterprises*	The Pas, Man.	170 BHK	n.a.
Alberta-Pacific*	Athabasca, Alta.	500 BHK/BSK**	1993
Procter & Gamble*	Grand Prairie, Alta.	250 BHK/BSK	n.a.
Repap Enterprises*	The Pas, Man.	450 BSK/BHK	n.a.
Celgar Pulp*	Castlegar, B.C.	200 BSK	n.a.
Canfor*	Prince George, B.C.	525 BSK	n.a.
U.S.			
Bowater	Calhoun, Tenn.	80 BHK	1990
ITT Rayonier	Jesup, Ga.	85 BSK	1990
Weyerhaeuser	Columbus, Miss.	425 BSK/BHK**	1990
Champion International	Quinnesec, Mich.	(100 BHK)	1990
Union Camp	Eastover, S.C.	100 BSK/BHK	1991
Stone Savannah River	Port Wentworth, Ga.	240 BHK	1991
Simpson	Pasadena, Texas	50 BSK	1991
Alabama River	Claiborne, Ala.	450 BSK/BHK**	1992
Gulf States*	Demopolis, Ala.	240 BSK**	1993
Pope & Talbot*	Halsey, Ore.	240 BSK	n.a.
WTD Industries*	Port Westwood, Ore.	300 BSK	n.a.
Potlatch*	Cloquet, Minn,	200**	1995
EUROPE			
Alicel	Alizay, France	120 BHK	1990
ENCE	Spain (two mills)	120 BHK	1990
Stora	Skütskar, Sweden	140 BHK	1990
Veitsiluoto	Oulu, Finland	(150 BSK)	1991
Soporcel	Lavos, Portugal	(150 BHK)	1991
Enocell (Enso/USSR)	Uimaharji, Finland	150 BHK/BSK**	1992
Celbi (Stora)	Figueira, Portugal	360 BHK	1992
Rauma	Rauma, Finland	90 BSK	1992
Cel. du Rhône (CRDA)	St. Gaudens, France	120 BHK/BSK	1994
	Tarascon, France	40 BSK	1994
Pojan Sellu*	Kajaani, Finland	135 BSK/BHK	n.a.
Metsä-Botnia*	Kaskinen, Finland	485 BSK/BHK**	n.a.
Södra*	Mönsterås, Sweden	400 BSK	n.a.
LATIN AMERICA			
Cel. Bahia (Klabin)	Camacari, Brazil	90 BHK**	1990
Aracruz	Espirito Santo, Brazil	525 BHK	1991
Cel. Santa Fe (Scott/Shell)	Nacimiento, Chile	240 BHK	1991
Cel. Pacifica (CMPC/Simpson)	Renaico, Chile	315 BSK	1992
Bahia Sul	Mucuri, Brazil	240 BHK	1992
Ripasa	Limeira, Brazil	(180 BHK)	1992
Simao	Jaceri, Brazil	160 BHK	1992
Puerto Piray	Misiones, Argentina	230 BHK/BSK	1992
Cel. Arauco	Arauco, Chile	350 BSK	1992
Cel. Attisholz	Lincantén, Chile	100 BSK	1993
Cenibra	Belo Oriente, Brazil	350 BHK	1993
Norcell (Riocell/Compene)	Bahia, Brazil	420 BHK	1994
Riocell	Guiaba, Brazil	310 BHK	1995
Ripasa/Simao*	Maranhao, Brazil	420 BHK	1997
Arauco/Stora*	Southern Chile	500 BSK	1997
Champion*	Mato Grosso, Brazil	350 BHK**	n.a.
ASIA			
Indah Kiat*	Riav, Indonesia	100 BHK**	1991
Dong Hae*	Kyungman, Rep. Korea	200 BHK	1991
Phoenix	Bangkok, Thailand	100 BHK	1992
Hyundai/USSR*	Olga, USSR	300 BSK	n.a.

*"Possible" projects. All other projects are considered "definite" or "probable."
**Not all pulp for market sale.
( ) = Indicates capacity withdrawal due to a new paper machine.
BSK = bleached softwood kraft; BHK = bleached hardwood kraft.
n.a. = Not available.

ized rate of 900,000 tpy, up 44% from a year earlier. However, shipments to the U.S. were up only 10% to a 264,000-tpy rate. Prices for softwood bleached CTMP were reported to be down close to $500/metric ton in the U.S. and northern Europe in the fall of 1990, with price levels for aspen grades slightly higher. This would be down from a price of about $640 in the U.S. for softwood BCTMP a year earlier. And prices in some Asian markets were reported to be in the $400/ton range. Prices for BCTMP are expected to remain under pressure in 1991, with new capacity entering the market and the rapid decline in bleached hardwood kraft pulp prices.

DISSOLVING PULP

Dissolving pulps, also referred to as chemical cellulose, are highly purified grades of market pulp composed of 95% to 99% cellulose. They are used to produce man-made fibers (rayon and acetate), films (cellophane), plastics (cellulose acetates), and chemicals (methyl cellulose and carboxylmethyl cellulose). Two processes are used to produce dissolving pulps—mainly from softwood although some hardwood is used: 1) the prehydrolyzed sulfate process and 2) the modified acid sulfite process. By these processes, several grades of varying quality can be made, each suitable for different end uses.

The quality of a dissolving pulp grade for a particular process depends on its purity and reactivity. For example, sulfite dissolving pulps are generally considered to be the most reactive pulps, suitable for producing rayon and cellophane made under lenient rayon (viscose) processing conditions. Prehydrolyzed sulfate pulps generally produce a stronger rayon fiber for uses such as high-wet-modulus textile rayon and high-tenacity rayon tire cords. Cotton linter is also used to produce cellulose acetates and cellulose plastics, but it is rarely used for producing rayon fibers.

Chemical cellulose products can be divided into four groups based on the processes—viscose, acetate, ethers, and nitration—used to convert them: 1) Viscose products are the largest group and consume about 80% of the dissolving pulp shipped. About 75% of viscose production consists of rayon for textiles and tire cord, with the remainder going into cellophane and products such as sausage casings and sponges. 2) Acetate products are the second-largest group and include textiles, cigarette filters, rigid packaging, photographic film, and high-quality plastics. 3) Cellulose ethers are increasingly being used in pharmaceuticals, cosmetics, detergents, food products, superabsorbents, and additives for oil-well drilling muds. 4) Cellulose nitrates are used in explosives, lacquers, printing inks, and rocket fuels.

Dissolving pulp demand has been declining in recent years due to inroads by lower-cost synthetic fibers and films. Rayon staple, for example, is under heavy competitive pressure from polyester, while plastic films such as oriented polypropylene are displacing cellophane. Demand has been stronger for high-performance rayons (such as high-wet-modulus staple, which offers cotton-like quality and high durability) and for cellulose ethers and nontextile acetate, such as cigarette filters tow (where demand is growing strongly in countries like China).

The most profitable markets for North American producers have been for the more specialized higher-alpha pulps produced by a few large southern U.S. mills using the prehydrolized kraft process. These mills include ITT Rayonier Inc. (Jesup, Ga.) Procter & Gamble Cellulose (Foley, Fla.), and International Paper Co. (Natchez, Miss.) Fewer competitors in more specialized market niches have kept prices for higher-alpha pulps more stable in market downturns. Pricing for more commodity-type viscose sulfite pulp is expected to more closely follow prices of paper pulps and plunge sharply in market downturns. This reflects the fact that some sulfite mills will shift production between sulfite paper and dissolving pulp.

WORLD CHEMICAL PAPER-GRADE MARKET PULP SHIPMENTS BY DESTINATION

(000 metric tons)

Year	U.S.	Canada	Western Europe	Nordic	Eastern Europe	Latin America	Japan	Asia/ Africa*	Oceania	Total
1989	5,150	940	11,045	1,025	330	1,335	3,225	2,940	295	26,285
1988	5,515	965	10,995	1,030	310	1,555	2,950	3,090	310	26,720
1987	5,310	970	10,540	1,135	295	1,785	2,780	3,220	360	26,395
1986	5,130	890	10,310	1,130	285	1,705	2,595	2,825	280	25,150
1985	4,700	845	9,445	1,000	210	1,620	2,395	3,010	225	23,450
1984	4,835	845	9,280	995	230	1,275	2,290	2,520	245	22,515
1983	4,720	735	9,145	980	255	1,015	2,260	2,955	255	22,320
1982	3,940	605	8,120	820	260	935	1,950	2,080	275	18,985
1981	4,325	750	9,010	930	380	865	1,800	2,095	315	20,470
1980	4,420	735	9,145	1,025	470	1,190	2,330	1,770	335	21,420

*Includes People's Rep. China (which purchased 470,000 metric tons from North American and Nordic suppliers in 1988—down from 520,000 tons in 1987 and the peak of 600,000 tons in 1983).

Another structural change in the dissolving pulp market has been the decline of the rayon industry in most industrial countries and the shift of the world textile industry to Asia. For example, Avtex Fibers Inc., the largest U.S. rayon producer, shut down production at its Port Royal, Va., plant in 1989 due mainly to environmental pressure—leaving only two remaining U.S. producers (BASF Fibers Div. and Courtaulds North America Co.). And in 1988, Courtaulds shut down the last cellophane manufacturing plant in Canada. The viscose dissolving pulp market is also affected by the presence of a large and low-cost player: Sappi Ltd.'s Saiccor mill in Umkomaas, South Africa, which has capacity to produce 450,000 tpy of viscose kraft eucalyptus dissolving pulp. The mill is being expanded by 100,000 tpy and may be given the capability to produce acetate-type pulp. Saiccor seems to dominate many Asian markets and is reputed to be a tough competitor when markets become weak.

Meanwhile, capacity to produce dissolving pulp, particularly for sulfite viscose grades, has been declining in most industrialized countries. This has been due to declining rayon demand, high production costs, growing environmental pressures on many older sulfite mills that are not economical to clean up, and more profitable opportunities in conversion to integrated paper pulp production. The result has been a decline in world dissolving pulp production from about 6.2 million tons in 1985 to 5.3 million tons last year, according to the annual UN/FAO capacity survey.

U.S. dissolving pulp production declined from a peak of around 1.6 million metric tons in the mid-1970s to a low of 988,000 tons in the 1982 recession. By 1989, it had recovered to 1.26 million metric tons. Canadian dissolving pulp production followed a similar trend, declining from a peak of 450,000 tons in 1969 to 268,000 tons in 1989. ITT Rayo-

U.S. DOMESTIC PRICES FOR BLEACHED KRAFT MARKET PULP

($/metric ton, delivered)

Year	Northern bleached softwood kraft	Southern bleached softwood kraft	Northern bleached hardwood kraft	Southern bleached hardwood kraft
1990				
3Q	$800*	$640*	$660*	$570*
2Q	830*	650*	680*	620*
1Q	830*	720*	745*	680*
1989				
4Q	830	800*	745/765*	700*
3Q	830	800*	745/765	735*
2Q	830	800	745/765	735
1Q	800	780	745	735
1988				
4Q	760	735/740	705	685/695
3Q	735	705/715	705	685/695
2Q	700	670	665	650
1Q	655	630	620	610
1987				
4Q	610	585	575	565
3Q	575	550	540	530
2Q	575	550	540	530
1Q	550	520	510	500
1986				
4Q	480	490	470	460
3Q	480	450	425	420
2Q	450	420	385	380
1Q	410	360/385	340/360	320/345
Year end				
1985	400*	360	330/360*	320*
1984	510*	475	460/470*	450*
1983	440	415/425*	410/420	390/400
1982	440	385*	364/380*	353*
1981	530/565	495	468/490*	424*
1980	530	507	490	480
1979	460	400	433	420
1978	375	353	342	330
1977	342*	287	276*	260*
1976	410	353	331	310
1975	410	353	369	353
1974	386	386	369	353
1973	259	246	248	213
1972	179	180	149	150
1971	165*	160	149*	148*
1970	188	180	171	170

*Indicates some discounting from price levels shown above.

HISTORIC PRICES, 1950-69, FOR NORTH AMERICAN MARKET PULP

Average annual prices for bleached kraft pulp, delivered in U.S. domestic market (US$/short ton)

Year	Northern bleached softwood kraft	Southern bleached softwood kraft	Northern bleached hardwood kraft	Southern bleached hardwood kraft
1969	$145	$133	$131	$129
1968	145	123	118	115
1967	150	129	130	124
1966	148	135	136	129
1965	150	144	135	133
1964	146	141	128	130
1963	139	132	130	124
1962	143	129	134	124
1961	145	135	135	130
1960	156	151	151	146
1959	157	157	152	152
1958	157	157	152	152
1957	153	155	151	150
1956	151	154	149	149
1955	146	149	144	144
1954	142	145	140	140
1953	142	145	140	140
1952	142	145	—	—
1951	139	—	—	—
1950	120	—	—	—

nier shut down a troubled 260,000-tpy sulfite dissolving and paper-grade pulp mill at Port Cartier, Que., in 1979, and CIP Inc. closed its older 91,000-tpy Hawkesbury, Ont., sulfite dissolving pulp mill at the end of 1982.

In addition, about 400,000 tons of capacity at eight mills in Western Europe were either shut down or converted to other grades during the 1981-85 period. This trend is continuing in Europe, where Rauma-Repola is phasing out dissolving pulp production at its 140,000-tpy mill in Finland and Saugbrugsforeningen will be doing the same at its 70,000-tpy line in Norway, both in 1992. Metsä-Serla is also studying options for its sulfite mill in Mänttä, Finland, which has capacity to produce 50,000 tpy of dissolving pulp. There has also been a substantial reduction in dissolving pulp capacity in the Soviet Union from 1.7 million tons in 1984 to 670,000 tons by 1989. Some large dissolving pulp mills reportedly have been closed or converted to other grades because of environmental problems.

The shakeout will probably continue since dissolving pulp prices for viscose rayon grades have once again come crashing down. Prices for 91-92 alpha viscose rayon pulp in the fall of 1990 reportedly have dropped below $600/metric ton c.i.f. in some southeast Asian markets after reaching highs of $900 to $1,000/ton during the market peak in the

U.S. DOMESTIC PRICES FOR OTHER PAPER-GRADE MARKET PULPS

($/metric ton, delivered)

Year	Bleached sulfite	Unbleached softwood kraft	Bleached CTMP softwood (80 GE bright)	Bleached eucalyptus
1990				
3Q	$690*	$600*	$520*	$680
2Q	720*	600*	560*	700*
1Q	750*	600*	580*	760*
1989				
4Q	790	625*	640*	760
3Q	790	650/665*	640*	780
2Q	790	650/665*	640	780
1Q	770	650/665*		760
1988				
4Q	730	650/665	625	720
3Q	715	650/665	600	720
2Q	660/670	635/665	560	—
1Q	610/620	590/620	525	—
1987				
4Q	565/575	545/575	485	—
3Q	530/540	505/540	440	—
2Q	530/540	505/540	440	—
1Q	505	475/510	420	—
1986				
4Q	470	440/480	385	—
3Q	440	420/440	385	—
2Q	410	405	360	—
1Q	355	360	330	—
Year end				
1985	355	360	360	—
1984	455	430	415	—
1983	420/430*	370	365	—
1982	420*	360*	—	—
1981	520	490	—	—
1980	520	490	—	—
1979	450	422	—	—
1978	358	310	—	—
1977	320*	280*	—	—
1976	400	380	—	—

*Indicates some discounting from price levels shown.

U.S. DOMESTIC PRICES FOR SPECIALTY PULPS

($/metric ton, delivered)

Year	Fluff (untreated bleached softwood kraft in rolls)	Dissolving (sulfite viscose staple grade, 91 to 92 alpha)
1990		
3Q	$800*	$650/700*
2Q	800*	800/830*
1Q	830*	880/900*
1989		
4Q	830	880/900
3Q	830	880/900
2Q	820/830	850/870
1Q	800	810/830
1988		
4Q	760	800/810
3Q	735	760/780
2Q	690/700	710/720
1Q	660	660/670
1987		
4Q	615	615/635
3Q	580	580/600
2Q	580	540/560
1Q	560	550
1986		
4Q	540	510
3Q	500	510
2Q	475	500
1Q	440	500
Year end		
1985	440	500
1984	535/555	530
1983	470*	525
1982	485*	530
1981	572/607	620
1980	550	670
1979	475	530
1978	—	430
1977	—	455
1976	—	468
1975	—	425

*Indicates some discounting from price levels shown.

first half of 1989. Prices are reported to be somewhat higher in the more industrialized northern Asian countries. Prices for viscose sulfite pulp in the U.S., Europe, and Japan were still reported to be in the low-to-mid-$700/ton range, and prices for higher-alpha acetate and ether pulps were reported to be holding up better.

NORTH AMERICAN EXPORT PRICES FOR BLEACHED KRAFT MARKET PULP

(US$/metric ton, c.i.f. northern Europe)

Year	Northern bleached softwood kraft	Southern bleached softwood kraft	Northern bleached hardwood kraft	Southern bleached hardwood kraft
1990				
3Q	$800*	$650*	$640*	$580*
2Q	840*	650*	670*	620*
1Q	840	700*	790*	680*
1989				
4Q	840	810	790	780*
3Q	840	810	790	780*
2Q	840	810	790	780
1Q	810	780	770	760
1988				
4Q	760	730	720	710
3Q	760	730	720	710
2Q	725	695	690	680
1Q	680	655	650	640
1987				
4Q	635	610	600	595
3Q	610	585	575	570
2Q	585	560	550	545
1Q	550	525	515	510
1986				
4Q	520	490	475	470
3Q	480	460	445	440
2Q	450	420	395	390
1Q	415	380	350	345
Year end				
1985	380/390*	355*	330	325*
1984	485*	465*	—	430*
1983	430*	400	—	385*
1982	420*	390*	—	360*
1981	545	500*	—	455*
1980	545	530	—	505
1979	465/475	450	—	435
1978	380	360	—	350
1977	350*	330/340*	—	300/320*
1976	415*	410*	—	405*
1975	415	410	—	405
1974	370	—	—	—
1973	232	—	—	—
1972	185	—	—	—
1971	185	—	—	—
1970	180	—	—	—

*Indicates some discounting from price levels shown.

The latest market decline will place pressure on older North American sulfite dissolving pulp mills, such as the two mills owned by Louisana-Pacific and Alaska Pulp Co., which also face timber supply problems. Nevertheless, a major Taiwanese company appears to be moving ahead

NORDIC AND EUCALYPTUS PULP PRICES IN EUROPE

(Deutschemarks [DM] or US$/metric ton, c.i.f.)

Year	Northern bleached softwood kraft	Nordic birch	Bleached eucalyptus
1990			
3Q	DM1,250*	DM1,040*	ECU500*
2Q	DM1,400*	DM1,250*	ECU610*
1Q	DM1,400	DM1,300	ECU640
1989			
4Q	DM1,630	DM1,520	DM1,505
3Q	DM1,630	DM1,520	DM1,505
2Q	DM1,530	DM1,440	DM1,440
1Q	DM1,430	DM1,340	DM1,340
1988			
4Q	DM1,430	DM1,340	DM1,340
3Q	DM1,315	DM1,240	DM1,240
2Q	DM1,250	DM1,190	DM1,190
1Q	DM1,180	DM1,130	DM1,130
1987			
4Q	DM1,180	DM1,130	DM1,075
3Q	DM1,125	DM1,075	DM1,075
2Q	DM1,125*	DM1,075	DM1,075
1Q	DM1,125*	DM1,075	DM1,075
1986			
4Q	DM1,100*	DM1,075	DM1,075
3Q	DM1,100*	DM1,025	DM1,025
2Q	DM1,080*	DM985	DM965/985
1Q	DM1,050*	DM910	DM900/$350
Year end			
1985	DM1,025*	DM875*	$330*
1984	DM1,425*	DM1,325*	$435*
1983	$430*	$400	$390/400
1982	$420*	$390	$380*
1981	$545	$520	$480*
1980	$545	$520	$520
1979	$465/475	$450	$445
1978	$380	$360	$345
1977	$350	$325*	—
1976	$415	$405*	—
1975	$415	$405	—
1974	$370	$362	—
1973	$232	$220	—
1972	$185	$180	—
1971	$185	$180	—
1970	$180	$170	—

*Indicates discounting. List prices shown for 1986-89.

Under price-fixing settlements reached with the European Economic Community, Nordic producers increasingly began to make sales in local currencies in the second half of 1984. Eucalyptus increasingly priced in European currency units (ECU).

with plans to build a dissolving pulp mill in Louisiana. Formosa Plastics is trying to obtain permits for a 1,000-tpd mill and a rayon plant. The company may then close its 200-tpd dissolving pulp mill in Taiwan.

The most hopeful development in the dissolving-pulp market is the progress being made toward improving the viscose process, which is highly capital- and energy-intensive and involves toxic and flammable chemicals. (In the process, cellulose is treated with caustic soda and carbon disulfide to form cellulose xanthate, which is then dissolved in a weak caustic solution to form the viscose used to spin rayon staple.) Courtaulds, for example, has been working for a number of years on a solvent spinning process that will make rayon processes more environmentally acceptable and rayon fibers more cost competitive with other fibers. The company has been operating a large pilot plant in England and last year announced plans to build the first production line for its Tencel solvent-spun fiber rayon plant near Mobile, Ala. The new plant will cost $80 million, will have an initial capacity of 40 million lb/year (20,000 tpy), and is scheduled to start up in 1992.

NORTH AMERICAN CHEMI-THERMOMECHANICAL PULP MILLS—EXISTING AND PROPOSED

Company	Location	Capacity (000 metric tpy)	Startup date
Quesnel	Quesnel River, B.C.	160 S/A[1]	1983/88
Temcell	Temiscaming, Que.	100 A/S/F	1986
Stone-Consolidated	Bathurst, N.B.	90 A/S[2]	1986
Cascades	Port Cartier, Que.	210 S/F	1988
Fibreco	Taylor, B.C.	180 S	1988
Millar Western	Whitecourt, Alta.	210 A/S	1988
Donohue-Matane	Matane, Que.	190 S	1990
Slave Lake Pulp	Slave Lake, Alta[3]	120 A	1990
Louisiana-Pacific	Chetwynd, B.C.	160 A	1991
Millar Western	Meadow Lake, Sask.[4]	240 A/S	1992
Temcell	Temiscaming, Que.	150 A/S[5]	n.a.
Shin Ho	Thunder Bay, Ont.	150 A[6]	n.a.
Cascades	Cabano, Que.	115 A	n.a.
Fibreco	Taylor, B.C.	180 A	n.a.
Alcan	Vanderhoof, B.C.	220 A/S	n.a.
Yuen Foong Yu	Alberta	240 A/S	n.a.
Orenda Forest	Stewart, B.C.	106 S	n.a.

A = hardwood (aspen); S = softwood (mainly spruce); F = fluff grade.
n.a. = Not available.

[1] Reflects about half of total mill capacity marketed by West Fraser; remainder mainly TMP shipped to Japanese partner, Daishowa Paper.

[2] Reflects about half of total capacity available for market sale (mainly unbleached).

[3] Owned 75% by Alberta Energy, 25% by MoDo of Seden.

[4] Owned 51% by Millar Western, 49% by Crown Management Board of Saskatchewan.

[5] About 70,000 tpy will be used in an adjacent bleached board machine.

[6] Abitibi-Price may take about one-third of output, with part going to a South Korean company.

[7] Would use chemi-pressurized groundwood process.

Source: *Pulp & Paper Week.*

FLUFF PULP

Fluff pulp is usually produced in roll form and shipped to manufacturers of sanitary disposable products who then disintegrate the thick pulp sheets into individual fibers to give their products bulk, softness, and high absorbency. Fluff pulp is used mainly in baby diapers, which account for about 80% of U.S. consumption. Other uses include adult incontinence products, tampons, sanitary napkins, underpads, and wipes.

Fluff pulp is made primarily from bleached softwood kraft (chiefly southern pine) and is similar to paper-grade pulp. It is somewhat more expensive to produce than other pulps, due to special sheet properties (which may include treatment with debonders) and packaging. Several North American sulfite mills are trying to increase fluff pulp production, although southern kraft appears to be favored for most applications because of its high absorbency. While mechanical fluff pulp production is growing in Europe and two new Canadian bleached CTMP mills are targeting the fluff market, acceptance in the U.S. market is uncertain.

Fluff pulp was the fastest-growing major end use for the U.S. market pulp industry; consumption rose at a 7% to 8% average annual rate during most of the past decade. But in 1987, U.S. consumption probably declined, and domestic demand is projected to show relatively slow growth throughout the 1990s. The reasons for this include lower U.S. birthrates, the already high penetration of disposable diapers in the U.S., and the growing use of superabsorbent material in new thinner "ultra"-style baby diapers, which contain less fluff pulp.

According to a study prepared by Kenneth E. Lowe for Marketing/Technology Service Inc. (M/TS) of Kalamazoo, Mich., the U.S. population of infants 30 months old and younger will peak around 1990 and then decline during the next decade. Disposable diapers have already captured 78% of the U.S. market at the expense of cloth diapers, and their share will probably increase to 90% by 2000. As a result, Lowe projected that disposable diapers in the U.S. will increase from 17.8 billion units in 1987 to 20 billion units by the year 2000—only an 11% increase.

At the same time, the growing use of superabsorbents is reducing the amount of fluff pulp required per diaper by about 30%. Superabsorbents can absorb up to 50 times their weight in liquid, thereby permitting the design of thinner baby diapers and less obtrusive adult incontinence products. Typically, about 5.0 g of superabsorbent material (usually polyacrylate powder or granules) is used per diaper. This results in a reduction of fluff pulp used in an average infant diaper from 50 g to 34.7 g.

Since their introduction several years ago, the diapers containing superabsorbents have captured nearly all of the U.S. diaper market. As superabsorbents have become more prevalent, U.S. fluff pulp consumption for use in baby diapers has dropped from an estimated 811,000-ton peak in 1986 to 715,000 tons in 1987. Lowe predicted it will decline further to 691,000 tons by 1990 and 680,000 tons by 2000. (Only estimates can be made of market size because fluff is included with paper-grade pulps for statistical purposes, and some producers guard their capacity figures.)

This loss in fluff pulp demand for baby diapers is expected to be made up largely by improved demand for adult incontinence products, due to an aging population and increased market penetration by disposables. Adult incontinence products currently consume about 121,000 tons of fluff pulp (about equally divided between retail and institutional markets), and demand is projected to roughly double to 252,000 tons by 2000.

As a result, overall U.S. domestic demand for fluff pulp will remain nearly constant, rising from about 900,000 tons in 1987 to 982,000 tons by the year 2000, Lowe estimated. The share of fluff pulp consumed in baby diapers will decline from about 81% currently to 69% by 2000, while use in adult incontinence products will rise from 6% to 26%. Use in feminine pads will remain relatively stable at 5% to 6%.

Stronger growth in export demand should help boost total U.S. fluff pulp production, which was an estimated 1.6 million tons in 1987. Of that amount, about 900,000 tons were consumed in the domestic market, and about 740,000 tons were exported, according to Lowe. Although North America supplies about 70% of total world fluff pulp demand, stronger growth should occur in Europe, Japan, and the less industrialized countries due to their growing use of disposable diapers. The market share of disposable diapers in Japan was expected to grow from about 8% in the early 1980s to 34% in 1986 and to more than 60% by 1990, according to Uni-Charm Corp., a major Japanese diaper manufacturer. The strong disposable unit growth should more than offset increasing use of superabsorbents in Japan and Europe.

Total U.S. effective fluff pulp capacity is estimated at nearly 2.0 million tons. Major producers with capacity shares over 20% include Weyerhaeuser Co., Buckeye Cellulose Corp., and International Paper. Next largest are ITT Rayonier at around 14% and Kimberly-Clark at nearly 9%, according to M/TS. Other smaller producers include Georgia-Pacific Corp., Tembec Inc., Western Forest Products Ltd., and Temple-Eastex Inc. Weyerhaeuser is believed to be the largest open market seller of fluff pulp, while P&G and K-C consume it mainly for captive use.

Total world effective fluff pulp capacity is estimated by the M/TS study at 2.8 million metric tons, 835,000 tons of which are outside North America. Most of this capacity is in Western Europe and includes about 200,000 tons of bleached CTMP. Major European players include Stora, Cellulose du Pin, Korsnäs-Marma AB, and Metsä-Serla.

Because it is more expensive to produce, fluff pulp normally sells at a premium to southern pine paper pulp (but seems to track the price of northern softwood more closely perhaps because of contractual arrangements). The list price for untreated softwood kraft fluff pulp in rolls at the recent market peak was $830/ton in the U.S. vs a list for southern pine paper pulp of $800/ton. While the price of southern pine had dropped to $650/ton by the fall of 1990, fluff pulp was reportedly selling in the high-$700 range.

The baby diaper business in the last few years has been marked by intense product development activity and shorter product cycles. About 80% of the U.S. diaper market is held by two companies: P&G (with Pampers and Luvs holding about a 50% share) and K-C (with Huggies at slightly over 30%). The remainder is split among more than a dozen companies (the largest include Johnson & Johnson's Chicopee Div., Weyerhaeuser, Whitestone Products Corp., and Pope & Talbot). While most private-label producers were able to adopt "ultra" superabsorbent diaper technology, they may have more difficulty imitating the next round of designs from P&G and K-C.

Concern about the growing solid waste problem has not caused much shift from disposables back to cloth diapers in the U.S. However, environmental concerns about dioxin are causing a major shift in the way fluff pulp is produced, with most producers shifting to low- or no-chlorine bleaching. For example, Weyerhaeuser Co.'s new 425,000-tpy bleached kraft softwood pulp mill in Columbus, Miss., uses almost no chlorine. In Europe, some diaper manufacturers,

NORTH AMERICAN DISSOLVING PULP PRODUCERS ESTIMATED MILL CAPACITIES[1]

(000 metric tons)

Company	Prehydrolyzed sulfate pulp	Sulfite pulps	Cotton linters
ITT Rayonier			
Fernandina Beach, Fla.	—	140	—
Jesup, Ga.	280	—	—
Port Angeles, Wash.	—	160	—
Hoquiam, Wash.	—	—[2]	—
Buckeye Cellulose			
Foley, Fla.	180	—	—
Memphis, Tenn.	—	—	110
Alaska Lumber & Pulp			
Sitka, Alaska	—	170	—
International Paper			
Natchez, Miss.	220	—	—
Tembec Forest Products			
Temiscaming, Que.	—	120	—
Louisiana-Pacific			
Ketchikan, Alaska	—	135	—
Western Pulp			
Port Alice, B.C.	—	130	—
Weyerhaeuser			
Cosmopolis, Wash.	—	65	—
Alpha Cellulose			
Lumberton, N.C.	—	—	40
Southern Cellulose			
Chattanooga, Tenn.	—	—	30
Total	680	920	180

[1] Estimates of dissolving pulp capacity include some paper and fluff pulp. American Paper Institute and Canadian Pulp & Paper Assn. estimate U.S. dissolving pulp capacity at 1.356 million tons and Canadian capacity at 252,000 tons for a total of 1.608 million tons.

[2] Hoquiam mill has been supplying only slush pulp to adjacent Grays Harbor Paper Co. mill in recent years.

such as SCA's Mölnlycke Peaudoce unit, introduced peroxide-bleached CTMP fluff diapers advertised as "environmentally friendly." However, P&G was able to counter this using "chlorine-free" bleached kraft fluff pulp and was able to gain market share (see section on Mechanical Pulp). The performance of CTMP-containing diapers has been inferior to that of kraft fluff diapers due to slower rate of absorbancy and poorer pad integrity, according to analysts.

PLANNED CHANGES IN WORLD DISSOLVING PULP CAPACITY

(000 metric tons)

	Capacity			Total change		Average annual change (%)	
	1984	1989	1994	1984-89	1989-94	1984-89	1989-94
World total	6,093	5,276	5,352	-817	76	-2.8%	0.3%
Developed market economies	3,573	3,561	3,555	-12	-6	-0.1	0.0
North America	1,585	1,638	1,607	53	-31	0.7	-0.4
Japan	449	325	325	-124	0	-6.3	0.0
Western Europe	1,054	1,178	1,203	124	25	2.2	0.4
Oceania	0	0	0	0	0	—	—
Others	485	420	420	-65	0	-2.8	0.0
Developing market economies	271	398	448	127	50	8.0	2.4
Africa	0	30	30	30	0	—	0.0
Latin America	76	98	98	22	0	5.2	0.0
Asia	195	270	320	75	50	6.7	3.5
Centrally planned economies	2,249	1,317	1,349	-932	32	-10.1	0.5
Asia	30	35	35	5	0	3.1	0.0
Eastern Europe	519	522	534	3	12	0.1	0.5
U.S.S.R.	1,700	760	780	-940	20	-14.9	0.5

Source: 1989 United Nations Food and Agriculture Organization survey, *Pulp and Paper Capacities*.

Fiber:

WASTEPAPER

Wastepaper is used as a lower-grade alternative to virgin pulp in the manufacture of paper and paperboard. Also referred to as paperstock, recyclable paper, and secondary fiber, it is not as widely used as woodpulp due to quality considerations; however, its growth rate will surpass that of woodpulp in the 1990s because of other factors. Successive repulping tends to lower the quality of recycled fiber, eventually making it unusable. Primary fibers are often added to maintain strength and other qualities.

Forces outside the marketplace will in this decade begin to have a pronounced effect on future use of wastepaper in paper and paperboard production. Throughout the world—but especially in the U.S.—a "green movement" is causing a change in the way consumers view products made from recycled materials, and producers are responding with new "recycled" and "recyclable" products. In addition, governments are rapidly reacting to solid waste problems by adopting laws to promote recycling.

The North American paper industry itself will spend hundreds of millions of dollars to convert a considerable portion of its capacity to incorporate at least some recycled fiber. A special survey conducted by the American Paper Institute in November 1989 found that U.S. mills' plans would account for a consumption level of 31.4 million short tons of wastepaper by 1995, a 50% increase in usage over the approximately 20 million short tons consumed in 1988. Most of the wastepaper consumed will be old corrugated containers (OCC) and old newspapers (ONP).

The percentage of recyclable paper used in overall fiber furnish in the U.S. did not change appreciably in the 1970s and 1980s. With only minor setbacks along the way, it grew in those 20 years from 21.5% in 1970 to just 25.4% in 1989. However, secondary fiber use will grow at twice the rate of woodpulp over the next three years, according to API. Consumption of wastepaper used in the manufacture of paper and paperboard will rise from 20.9 million short tons in 1989 to nearly 25 million short tons in 1992, reflecting an average annual growth rate of 6.2%. The percentage of recycled fiber to woodpulp will increase to 27.2% by 1992, while woodpulp will decline to 72.8% of fiber supply in 1992 from 74.6% in 1989.

Wastepaper utilization—the ratio of secondary fiber used in proportion to total paper and paperboard produced—has also varied only slightly during more than two decades. Between 1965 and 1978, it remained at about 23%. After 1978, though, it crept past 24% and topped 25% in both 1987 and 1988. In 1989, it jumped two percentage points to 27.3% and is expected to exceed 29% in 1990.

Aside from slight increases in utilization rates and ratios of usage in overall fiber furnish, the wastepaper market in 1989 was driven by record U.S. mill consumption of 20.887 million short tons. International trade was also robust in 1989, with U.S. paperstock exports reaching a new high of 6.307 million short tons. Major consuming countries in recent years have been Taiwan, Rep. Korea, Mexico, Japan, Canada, Italy, Spain, and India.

The industry uses two main indicators of wastepaper consumption: the utilization rate and the ratio of wastepaper used to total fiber furnish. Utilization is calculated as a ratio of wastepaper consumed to total paper and paperboard produced. The utilization rate is slightly higher than the other figure due to the loss of fiber in papermaking.

Data on wastepaper consumption are collected by the Dept. of Commerce and API in the U.S. and by the Canadian government and the Canadian Pulp & Paper Assn. in Canada. API figures are generally higher than those from the Dept. of Commerce because API includes inplant and intraplant use of paper machine trim and broke.

SUPPLY

The wastepaper industry collects material from many sources, sorts and segregates it into various types, and processes it for ease of handling, transport, and subsequent repulping. Balers and other costly equipment are required to perform these functions. The collection of wastepaper also provides important secondary services, such as reduction of solid wastes and savings on garbage disposal costs.

Sources of paperstock are categorized generally as either preconsumer or postconsumer. Preconsumer generators of secondary fiber are primarily converting plants and printers. Converting plants produce recyclable products such as envelopes, books, and business forms. Printers are sources for materials such as magazines, directories, and catalogs. In these operations, waste is generated from machine trim as well as from other manufacturing operations. Postconsumer generators of waste include residential homes, factories, offices, and retail outlets.

In determining the supply of paperstock, industry experts watch the recovery rate. This is defined by API as the ratio of recyclable paper collected to new supply of paper and board. (New supply of paper and board equals production plus imports less exports, excluding hard pressed board. Imports and exports include paper and paperboard converted products.)

Overall, the recyclable recovery rate has been climbing for the past two decades, with minor setbacks along the way. It has hovered at about 26% since 1980, but that barrier was broken in 1986 when the rate jumped to 28%. This was due not only to a 13.3% rise in exports but also to a 7.4% increase in the amount of recyclable paper recovered.

The collection of wastepaper continued to rise in the closing years of the 1980s. In 1987, it reached 24.033 million tons for a 28.8% recovery rate; in 1988, 26.179 million tons (29.9% recovery); and in 1989, 27.601 million tons (32.4% recovery). By the year 2000, recovery of wastepaper is expected to reach 39.250 million tons for a recovery rate of 38.5%, according to a report for API prepared by Franklin Associates Ltd.

GOVERNMENT ACTION

An increasing amount of paper and paperboard is being recycled because of growing concern about the environment and because of the need to find alternate means of municipal waste disposal. In this decade, densely populated areas—particularly in the northeastern U.S.—have had to close down most of their landfills and look for other disposal methods.

The U.S. generates about 160 million tpy of municipal solid waste, and approximately 84% of this is disposed of in landfills. About 75% of these landfills will close by the year 2005. By the year 2000, the U.S. will be short 56 million tpy of disposal capacity, according to attorney William

WASTEPAPER UTILIZATION BY U.S. PAPER AND BOARD MILLS, BY GRADE

(000 short tons)

Year	Total	Mixed papers	%	Newspapers	%	Corrugated	%	Pulp substitutes*	%	Deinking	%
1992e	24,983	2,531	10.1%	3,970	15.9%	12,857	51.5%	3,318	13.3%	2307	9.2%
1991e	23,739	2,458	10.3	3,817	16.1	11,978	50.5	3,242	13.7	2,244	9.4
1990e	22,568	2,341	10.4	3,690	16.3	11,424	50.6	3,087	13.7	2,025	9.0
1989	20,877	2,244	10.7	3,337	16.0	10,533	50.5	2,901	13.9	1,863	8.9
1988	19,887	2,182	11.0	3,215	16.2	9,909	49.8	2,889	14.5	1,691	8.5
1987	19,201	2,116	11.0	3,442	17.9	9,177	47.8	2,903	15.1	1,563	8.3
1986	18,128	2,045	11	3,118	17	8,634	48	2,761	15	1,570	9
1985	16,550	1,902	12	2,875	17	7,899	48	2,494	15	1,380	8
1984	16,883	1,975	12	2,895	17	7,972	47	2,673	16	1,369	8
1983	15,822	1,908	12	2,692	17	7,443	47	2,456	16	1,323	8
1982	14,620	1,707	12	2,673	18	6,770	46	2,247	15	1,224	8
1981	15,883	2,356	15	2,667	17	7,231	46	2,382	15	1,247	8
1980	15,094	2,268	15	2,564	17	6,866	45	2,254	15	1,142	8
1979	15,520	2,648	17	2,480	16	6,967	45	2,308	15	1,117	7
1978	14,760	2,729	18	2,212	15	6,721	45	2,242	15	1,068	7
1977	14,288	2,773	19	2,287	16	6,205	43	2,079	14	944	7
1976	13,822	2,798	20	2,278	17	5,696	41	2,117	15	933	7
1975	11,983	2,606	22	2,040	17	4,743	40	2,594*	22	—	—
1974	14,196	3,118	22	2,408	17	5,716	40	2,955*	21	—	—
1973	14,318	3,371	24	2,456	17	5,292	37	3,199*	22	—	—
1972	13,132	3,054	23	2,317	18	4,722	36	3,037*	23	—	—
1971	12,323	2,776	22	2,174	18	4,277	35	3,097*	25	—	—
1970	12,021	2,639	22	2,235	19	4,080	34	3,067*	25	—	—

* Pulp substitutes include deinking grades prior to 1976.

e = American Paper Institute estimate.

Source: American Paper Institute Capacity Survey for relevant years, 1970-92.

L. Kovacs of the law firm Dunn, Carney, Allen, Higgins & Tongue based in Washington, D.C. Because wastepaper accounts for almost half of all solid waste, the paper industry will inevitably be involved in efforts to recycle more of it.

Early in 1990, API announced that the industry had set a goal of 40% collection rate of all paper used in the U.S. by the end of 1995. To meet this, the collection system will be challenged, especially as new mills, new machines in existing mills, and increases in capacity of machines currently making recycled paper and paperboard come onstream.

The paper industry has recycled for hundreds of years, but never has it been forced to absorb so much additional recycled fiber. The problem started as a number of isolated solid waste problems began to crop up. The Islip (Long Island) barge incident is seen as a major turning point in public perception, but New Jersey's garbage crisis really set some legislative wheels in motion. New Jersey closed all but 20 of its landfills by 1984, and no new ones were sited. In 1987, a law was passed requiring all communities to mandate recycling programs. However, the state did not consider where all that additional collected recycled material was going to be marketed.

Many states followed New Jersey's lead by setting up their own recycling systems or by studying such programs. They include Minnesota, Massachusetts, New York, California, Connecticut, Florida, Georgia, Pennsylvania, Maryland, Virginia, Wisconsin, Illinois, District of Columbia, Louisiana, Vermont, Maryland, and Rhode Island.

As these recycling programs began to generate more recyclables, it became apparent that demand for them was not growing proportionately. Something had to be done to expand the marketplace. Some states, in the interim, paid mills to take the excess old newspapers rather than paying high tipping fees at landfills or paying to transport the solid waste hundreds of miles. Some recycling centers shut down because they couldn't make a profit in such a market.

Now, states are adopting new laws to promote markets for recyclables. So far, this has concentrated mainly on getting newsprint producers to use more old newspapers in their fiber furnishes (see Newsprint chapter). More recently, though, states are looking at laws to stimulate recycled

UTILIZATION OF WASTEPAPER BY U.S. PAPER/BOARD MILLS

(000 short tons)

Year	Wastepaper used*	Paper/board produced	Utilization rate (%)
1992e	24,983	n.a.	n.a.
1991e	23,739	n.a.	n.a.
1990e	22,566	76,646	29.4
1989	20,887	76,466	27.3
1988	19,887	77,903**	25.5
1987	19,201	75,908**	25.3
1986	18,128	72,489	25.0
1985	16,550	68,658**	24.1
1984	16,883	70,268**	24.0
1983	15,822	66,764**	23.7
1982	14,620	60,962**	24.0
1981	15,883	64,259	24.7
1980	15,094	63,537	23.8
1979	15,520	64,345	24.1
1978	14,760	62,047	23.8
1977	14,288	60,040	23.8
1976	13,822	58,329	23.7
1975	11,983	50,976	23.5
1974	14,196	59,040	24.0
1973	14,318	59,900	23.9
1972	13,132	57,433	22.9
1971	12,323	53,162	23.2
1970	12,021	51,671	23.3

e = Estimate.

*Includes the following tonnage consumed in the manufacture of molded pulp products: 1982, 187,000 tons; 1983, 174,000 tons; 1984, 157,000 tons; 1985, 179,000 tons; 1986, 191,000 tons; 1987-89, 202,000 tons.

**Includes the following tonnages for construction and wet machine board grades: 1982, 1,662,000 tons; 1983, 1,800,000 tons; 1984, 1,800,000 tons; 1985, 1,700,000 tons; 1986, 1,600,000 tons; 1987 and 1988, 1,590,000 tons.

Sources: Wastepaper utilization from American Paper Institute Capacity Survey for relevant years. Production totals from API "Statistics of Paper, Paperboard & Wood Pulp" and from "Paper, Paperboard & Wood Pulp Monthly Statistical Survey."

U.S. WASTEPAPER DOMESTIC UTILIZATION AND EXPORTS

(000 short tons)

Year	Used	Exported	Total	Exports as percent of total
1989	20,877	5,961	26,838	22%
1988	19,887	5,640	25,527	22
1987	19,201	4,418	23,623	19
1986	18,128	3,724	21,636	17
1985	16,550	3,283	19,657	17
1984	16,883	3,268	19,959	16
1983	15,822	2,393	18,212	13
1982	14,620	2,127	16,560	13
1981	15,883	2,213	17,659	13
1980	15,094	2,664	17,972	15
1979	15,520	2,233	17,594	13
1978	14,760	1,599	16,359	10
1977	14,288	1,512	15,570	10
1976	13,822	1,273	14,895	9
1975	11,983	861	12,843	7
1974	14,196	1,307	15,289	9
1973	14,318	683	14,777	5
1972	13,132	415	13,340	3
1971	12,323	419	12,525	3
1970	12,021	408	12,211	3

Sources: American Paper Institute Capacity Survey; Dept. of Commerce.

fiber demand in other sectors of the paper industry, such as printing/writing grades and packaging. States and municipalities are also requiring their purchasing agents to procure paper containing certain percentages of recycled fiber. By the beginning of 1990, 23 states had preferential procurement laws.

The federal government has had to buy recycled paper since June 1989, according to Section 6002 of the Resource Conservation and Recovery Act (RCRA). On June 14, the Government Printing Office accepted its first bid for printing/writing paper specifying recovered material content.

The federal law states that all agencies of the federal government must implement a preference purchasing program favoring recycled items. This applies to state and local government agencies funded by the federal government that buy $10,000 or more of the designated grades.

The paper procurement guideline was established by the Environmental Protection Agency and applies to 24 paper and paperboard grades. For example, newsprint must contain at least 40% postconsumer wastepaper. Offset printing paper, envelopes, mimeograph and duplicating paper, ledger, bond, book paper, and stationery must contain 50% recycled wastepaper. Toilet tissue must contain 20% postconsumer wastepaper, towels must contain 40%, and corrugated cartons must contain 35%. Information on the federal procurement program can be obtained from the EPA procurement guidelines hot line: (703) 941-4452.

In Canada, the federal government is trying to stimulate demand for recycled paper products through its Environmental Choice Program. Canada has no federal mandatory procurement law. The Environmental Choice Program is voluntary. Manufacturers apply to the Canadian Standards Assn. for a license allowing them to display the three-dove symbol of the Environmental Choice Program on their products. The success of the program relies on the consumer making a choice in the marketplace.

To display the symbol, a manufacturer not only must meet certain requirements related to recycled content but also must pass performance standards; plus, the mill itself must adhere to federal and provincial environmental control regulations.

Canada's Environmental Choice Program is modeled after the "Blue Angel" program operating in West Germany since 1978. To date, four countries are licensing products on the basis of specific environmental benefits: West Germany, Canada, Norway, and Japan. Eleven other countries are developing similar programs.

This is in contrast to the mandatory approach taken in the U.S. States are approaching this new regulatory arena in an array of inventive ways, with hundreds of proposals being reviewed per session. Manufacturers are finding it difficult to keep up with the regulations. According to API, municipal solid waste proposals being considered for adoption in state legislatures in mid-1989 included the following categories (with the number of proposals in parentheses): bans and degradable requirements (68), packaging taxes and restrictions (42), source separation and recycling (227), state purchasing preference (37), and waste-to-energy (66).

The states have taken action because EPA has so far opposed congressional efforts to legislate source reduction. EPA prefers to rely on effecting a "cultural change" at the local level. It plans to award a small amount of grant money and technical assistance to states and municipalities to encourage recycling. EPA has set a national goal of 25% municipal solid waste recycling by 1992 and 50% by 2008. This program might be accelerated by Congress, as it plans to reauthorize the RCRA.

COLLECTION SYSTEMS

Collection systems differ for the major categories of wastepaper. ONP used to be generated by residences and donated to nonprofit organizations during paper drives. With the spread of mandatory recycling efforts, however, many nonprofit organizations have chosen other fund-raisers because collecting ONP is no longer profitable.

API reported that total collection of ONP in 1989 was 5.13 million short tons, an increase of 7.2% from 1988 and up 47.2% from 1983. API estimated that the tonnage recovered in 1989 was equal to 37% of the newsprint used in the U.S. and forecast that recycling of ONP will grow during the 1990s above the rate of U.S. newsprint consumption.

WASTEPAPER AS PERCENT OF FIBER FURNISH IN U.S. PAPER/BOARD PRODUCTION

(000 short tons)

Year	Wastepaper	Total woodpulp other fibers	Percent of wastepaper
1992e	24,983	66,933	27.2
1991e	23,739	65,475	26.6
1990e	22,568	63,007	26.4
1989	20,887	61,346	25.4
1988	19,887	59,773	24.9
1987	19,201	59,887	24.4
1986	18,128	58,105	24.6
1985	16,550	54,566	23.7
1984	16,883	55,174	23.3
1983	15,822	51,834	23.2
1982	14,620	48,440	23.2
1981	15,217	51,764	22.7
1980	15,094	51,028	22.8
1979	15,400	51,303	23.1
1978	14,760	54,074	21.5
1977	14,288	49,799	22.3
1976	13,822	48,082	22.3
1975	11,983	43,104	21.8
1974	14,196	49,130	22.4
1973	14,318	49,558	22.4
1972	13,132	48,032	21.5
1971	12,323	44,805	21.5
1970	12,021	43,802	21.5

e = Estimate
Calculated by *Pulp & Paper* from American Paper Institute data.

PRICES FOR WASTEPAPER BY SELECTED GRADE IN FOUR MARKETS

($/short ton, f.o.b. seller's dock)

NO. 6 NEWS

	NYC	Chicago	Atlanta	SF-LA
1990				
2Q	$-1.66	$22.50	$12.50	$28.33
1Q	-5.00	15.00	12.50	27.50
1989				
4Q	-16.00	12.50	12.50	26.66
3Q	-5.00	7.50	14.16	23.33
2Q	9.16	11.66	21.66	34.16
1Q	17.50	22.50	27.50	42.50
1988				
4Q	35.00	30.00	35.83	45.00
3Q	45.83	42.50	52.50	59.16
2Q	50.00	44.16	52.50	68.33
1Q	58.30	55.00	54.16	78.33
Year end				
1987	60.00	57.50	57.50	75.00
1986	32.50	32.50	45.00	55.00
1985	25.00	22.50	30.00	40.00
1984	42.50	47.50	42.50	45.00
1983	42.50	47.50	47.50	51.25
1982	30.00	37.50	32.50	45.00
1981	27.50	22.50	32.50	30.00
1980	45.00	50.00	57.00	53.50

OLD CORRUGATED CONTAINERS

	NYC	Chicago	Atlanta	SF-LA
1990				
2Q	$16.66	$27.50	$37.50	$47.50
1Q	12.50	22.50	37.50	57.75
1989				
4Q	17.50	27.50	28.33	58.50
3Q	20.83	23.33	27.50	60.83
2Q	29.16	29.16	30.83	60.83
1Q	35.00	32.50	37.50	57.50
1988				
4Q	43.33	37.50	39.16	60.00
3Q	55.83	45.83	60.00	76.66
2Q	51.66	42.50	50.00	82.50
1Q	52.50	47.50	49.17	92.50
Year end				
1987	50.00	47.50	70.00	102.50
1986	42.50	50.00	55.00	82.50
1985	22.50	25.00	32.50	50.00
1984	37.50	46.25	50.00	50.00
1983	47.50	60.00	67.50	70.00
1982	30.00	30.00	37.50	32.50
1981	27.50	33.50	34.50	40.00
1980	33.00	44.00	43.00	57.00

Note: Prices reflect paper and board mill purchase prices, f.o.b. seller's dock exclusive of delivery charges, and they represent contract rather than spot or premium sales.
Source: *Pulp & Paper Week.*

PRICES FOR WASTEPAPER BY SELECTED GRADE IN FOUR MARKETS

($/short ton, f.o.b. seller's dock)

NEW DOUBLE-LINED KRAFT CORRUGATED CLIPPINGS

	NYC	Chicago	Atlanta	SF-LA
1990				
2Q	$68.33	$65.83	$69.16	$98.33
1Q	65.00	67.50	72.50	105.00
1989				
4Q	65.83	70.83	72.50	117.50
3Q	75.83	84.16	77.50	127.50
2Q	72.50	72.50	73.75	127.50
1Q	57.50	57.50	62.50	107.50
1988				
4Q	69.16	67.50	75.83	109.16
3Q	93.33	94.16	95.83	124.16
2Q	90.83	92.50	97.50	125.83
1Q	99.16	102.50	107.50	134.16
Year end				
1987	85.00	92.50	97.50	135.00
1986	82.50	77.50	82.50	117.50
1985	42.50	37.50	52.50	77.50
1984	77.50	83.75	77.50	92.50
1983	72.50	77.50	82.50	100.00
1982	45.00	47.50	47.50	70.00
1981	n.a.	n.a.	n.a.	n.a.
1980	n.a.	n.a.	n.a.	n.a.

HARD WHITE SHAVINGS

	NYC	Chicago	Atlanta	SF-LA
1990				
2Q	273.33	335.00	331.66	356.66
1Q	308.75	350.00	366.25	392.50
1989				
4Q	327.50	368.33	386.66	404.16
3Q	358.33	398.33	400.00	414.16
2Q	358.00	399.16	403.33	410.83
1Q	355.00	375.00	375.00	385.00
1988				
4Q	$335.00	$363.33	$355.00	$368.33
3Q	343.33	365.00	353.33	360.00
2Q	323.33	341.66	340.00	335.00
1Q	320.00	331.66	336.66	345.00
Year end				
1987	300.00	310.00	315.00	345.00
1986	265.00	275.00	255.00	295.00
1985	180.00	145.00	160.00	190.00
1984	245.00	205.00	240.00	245.00
1983	212.50	215.00	210.00	195.00
1982	200.00	195.00	190.00	180.00
1981	252.50	231.00	232.50	237.50
1980	251.50	278.50	260.00	269.50

Note: Prices reflect paper and board mill purchase prices, f.o.b. seller's dock exclusive of delivery charges, and they represent contract rather than spot or premium sales.
n.a. = Not available.
Source: *Pulp & Paper Week.*

OCC are obtained mostly from retail stores, factories, and office buildings. Only about 25% is supplied by postconsumer sources. Corrugated collections in 1989 totaled 13.4 million short tons, about 8% above the previous year. The 1989 collection rate was about 50%—5% higher than the previous year. During 1989, new programs were developed for hotels, motels, restaurants, fast-food outlets, and airports. These programs were expected to generate increased amounts of OCC in 1990 to meet increased demand.

Mixed papers are generated mostly in office buildings and are collected by private haulers. When demand is poor and prices fall, haulers usually cease picking up mixed papers because their price drops below a level that makes collection profitable. Collection of mixed papers totaled about 3 million short tons in 1989. The collection of mixed papers is not growing because office recycling programs are presorting computer printout (CPO) paper and sorted white ledger (SWL), both formerly large portions of mixed but now in the high presort demand.

High grades of wastepaper are usually obtained from large office buildings, where an agreement is worked out with a paperstock dealer. More corporations and commer-

PRICES FOR WASTEPAPER BY SELECTED GRADE IN FOUR MARKETS

($/short ton, f.o.b. seller's dock)

MANIFOLD COLORED LEDGER

	NYC	Chicago	Atlanta	SF-LA
1990				
2Q	$113.33	$128.33	$115.00	$145.00
1Q	125.00	140.00	135.00	160.00
1989				
4Q	128.33	145.00	135.00	144.16
3Q	125.00	145.00	131.66	144.16
2Q	115.00	141.66	127.50	141.66
1Q	112.50	140.00	127.50	152.50
1988				
4Q	119.16	150.00	138.33	159.16
3Q	125.00	160.00	150.83	173.33
2Q	125.00	153.33	149.16	165.83
1Q	122.50	146.66	138.33	128.33
Year end				
1987	112.50	137.50	120	107.50
1986	72.50	85.00	90.00	95.00
1985	72.50	80.00	70.00	70.00
1984	115.00	125.00	120.00	117.50
1983	112.50	105.00	90.00	65.00
1982	67.50	90.00	85.00	55.00
1981	110.00	112.50	107.50	115.00
1980	127.50	122.50	127.50	127.50

Note: Prices reflect paper and board mill purchase prices, f.o.b. seller's dock exclusive of delivery charges, and they represent contract rather than spot or premium sales.
Source: *Pulp & Paper Week.*

PRICES FOR WASTEPAPER BY SELECTED GRADE IN FOUR MARKETS

($/short ton, f.o.b. seller's dock)

COMPUTER PRINTOUT (No. 42)*

	NYC	Chicago	Atlanta	SF/LA
1990				
2Q	$211.66	$209.16	$200.00	$231.66
1Q	235.00	217.50	212.50	290.00
1989				
4Q	255.00	234.16	215.00	300.00
3Q	260.83	232.50	215.00	281.66
2Q	230.83	206.66	223.33	271.50
1Q	210	200.00	252.50	297.50
1988				
4Q	213.33	205.00	273.33	301.66
3Q	236.66	215.00	290.00	326.66
2Q	230.00	205.00	285.00	301.66
1Q	221.66	191.66	269.16	296.66
Year end				
1987	197.50	170.00	240.00	295.00
1986	145.00	165.00	170.00	187.50
1985	135.00	125.00	142.50	170.00
1984	205.00	170.00	205.00	245.00
1983	172.50	160.00	155.00	190.00
1982	170.00	145.00	155.00	192.50
1981	177.50	203.50	183.50	178.50
1980	175.50	195.00	158.50	199.00

MANIFOLD WHITE LEDGER

	NYC	Chicago	Atlanta	SF/LA
1990				
2Q	$168.33	$174.16	$183.33	$186.66
1Q	190.00	187.50	210.00	242.50
1989				
4Q	198.33	204.16	210.00	247.50
3Q	205.00	206.66	209.16	225.83
2Q	183.33	188.33	199.16	218.33
1Q	165.00	177.50	185.00	202.50
1988				
4Q	170.83	186.66	193.33	202.50
3Q	181.66	205.00	233.33	215.00
2Q	176.66	194.16	200.00	200.83
1Q	170.00	183.33	183.33	198.33
Year end				
1987	155.00	165.00	172.50	195.00
1986	107.50	107.50	115.00	125.00
1985	92.50	92.50	90.00	100.00
1984	146.25	145.00	140.00	147.50
1983	132.50	125.00	109.50	120.00
1982	90.00	100.00	95.00	105.00
1981	137.50	128.50	131.00	146.00
1980	136.50	151.50	140.50	160.50

*One hundred percent laser content.
Note: Prices reflect paper and board mill purchase prices, f.o.b. seller's dock exclusive of delivery charges, and they represent contract rather than spot or premium sales.
Source: *Pulp & Paper Week.*

cial landlords are collecting office papers to reduce their waste disposal costs and to make some additional money from selling the refuse. Usually this is done by having employees sort their own office discards and take them to a central collection point in the building, where the refuse is subsequently picked up by a private hauler.

Total collection of high grades for deinking and pulp substitutes in 1989 was 6 million short tons, down 3% from the previous year. Growth in this category is expected to be limited by the amount of clippings and cuttings generated in factories making paper products such as envelopes, business forms, and printed brochures. Yet demand for the high grades will remain healthy as mills shift more of their fiber furnish requirements from woodpulp to secondary fiber.

More businesses in both the U.S. and Canada, though, are recycling their office waste. These wastepaper grades, like CPO paper and ledger grades, bring a higher price on the market than ONP. The Office of Paper Recycling Services in New York City estimates that the average office worker produces at least 1 lb/day of wastepaper. In early 1989, API estimated that corporations in the U.S. recycle about 200,000 tpy of paper compared with virtually nothing ten years ago. Some corporations find that they save money on their trash bill by having recycling plants haul away their paper trash. Paper generated by offices is cleaner than that of homes, and it is more desirable to packers, who compete for the right to haul away wastepaper from big office buildings.

GRADES

Mixed papers, news, old corrugated containers, pulp substitutes, and deinking are the five official grade categories used by the Dept. of Commerce and generally accepted by the industry as key benchmarks for numerous other grades.

The Paper Stock Institute of America (a division of the Institute of Scrap Recycling Industries) subdivides the five classifications into more definitive grades. These include 51 regular grades that comprise the bulk of the wastepaper traded in the U.S. and Canada, along with 33 specialty grades that are sold to a limited number of mills able to use them in their product mixes. The specialty grades generally include contaminants, such as plastic coatings and foil, which restrict their use.

Grade characteristics are as follows:

- Mixed paper: paper of varied quality, often office waste; also boxboard cuttings and mill wrappers.
- News: old newspapers, either collected from households or overissues at newsstands or inplant; also groundwood paper trim.
- Old corrugated containers: used corrugated containers; also container plant cuttings.
- Pulp substitutes: unprinted grades of brown and colored kraft, white and semibleached sheets and cuttings, tabulating cards, and shavings or trim of unprinted grades.
- Deinking: deinking grades of white and colored ledger, computer printout, coated book and groundwood paper, and bleached sulfate sheets and cuttings.

Definitions. With increased government involvement in recycling, various definitions of recycled fiber and recyclable products have been used in proposed bills, adopted laws, and negotiated agreements. This has led to much confusion about how to label products and fibers to qualify as recycled.

The Paper Stock Institute uses the term paperstock and defines it as "fiber used for repulping," with further elaboration in its "Scrap Specifications Circular 1990," which includes classifications for 51 regular and 33 specialty grades of paperstock. PSI also uses the term recycled good, meaning "any material or good remanufactured using material diverted or separated from solid waste disposal or sold or distributed in interstate commerce, or reused as a direct

U.S. WASTEPAPER EXPORTS TO MAJOR CONSUMING COUNTRIES (1989)

(short tons)

Country	Printed news	High-grade deinking	High-grade pulp substitutes	Corrugated	Mixed	Total	Percent of market
Rep. Korea	311,380	297,032	61,464	249,693	311,156	1,230,726	20.24
Mexico	102,471	69,821	143,348	612,867	242,390	1,170,896	19.26
Taiwan	223,155	114,614	71,062	532,565	227,339	1,168,736	19.23
Japan	5,980	56,865	14,330	353,081	100,189	530,445	8.73
Canada	15,702	67,222	19,796	109,435	72,223	284,378	4.68
Spain	26,677	27,588	4,388	122,661	62,007	243,321	4.00
Italy	32,306	21,630	7,724	126,240	34,166	222,066	3.65
Philippines	19,165	41,405	6,172	49,522	6,928	123,191	2.03
Total exports	736,836	696,177	328,284	2,156,064	1,056,398	4,973,758	81.82

Source: Dept. of Commerce as reported by the Institute of Scrap Recycling Industries.

substitute for other goods sold or distributed in interstate commerce."

API has a set of its own terms. Recyclable paper, for instance, means "paper separated at its point of discard or from the solid waste stream for use as a raw material in the manufacture of a new product . . . often called wastepaper or paperstock." API further describes wastepaper as "any paper or paper product that has lost its value from its original purpose and has been discarded, including any waste or scrap generated from paper converting operations, such as printing plant waste and envelope cuttings, as well as discarded products such as boxes or newspapers."

EPA, on the other hand, makes a distinction between materials recovered from the solid waste stream and those recovered within a manufacturing operation. This has been at the root of the disagreement between EPA and the paper industry. The paper industry, on the one hand, claims that preconsumer waste reclaimed from the manufacturing process would otherwise end up in the solid waste stream. But EPA wants only postconsumer waste included in products labeled recycled.

MARKETS

Markets for the various grade classifications of wastepaper are essentially different, although there is some crossover in the types of paper and board made from different furnishes. Clay-coated newsback can incorporate OCC, ONP, and pulp substitutes, for example.

Mixed papers, the cheapest grade of paperstock, is used in construction paper and paperboard products such as roofing felts and gypsum wallboard. A shift from paper-based roofing to fiberglass-based shingles has cut demand substantially for mixed papers in this market. In addition, the construction business has not been robust in recent years, with U.S. housing starts dropping overall since 1983.

Demand for OCC, mainly from linerboard and corrugating medium mills, has risen dramatically in recent years. Between 1983 and 1989, U.S. mills increased their usage of OCC (as well as new double-lined kraft corrugated clippings) by 42%. This growth in secondary fiber demand was paced by advances in paper machine technology and contaminant removal systems (see chapters on linerboard and corrugating medium). These developments have kept OCC prices more resistant to fluctuations in the market. During first-half 1990, prices for other grades of paperstock plummeted, while OCC prices dropped only modestly (see table).

The ONP market, however, is being severely undermined by a glut of supply caused by mandatory source-separation and collection laws. For example, the mill price for ONP in the Northeast in fourth-quarter 1989 averaged -$16/short ton. Thus, mills were paid an average of $16/ton to take the fiber. This is because municipalities would rather pay the relatively modest fee of $16/ton to get rid of excess paper than pay as much as $100/ton or more to dispose of it at a landfill.

The transaction price of ONP, however, is often hard to determine because mills usually keep prices at artificially inflated levels so that those who make a living packing and sorting ONP can stay in business. Essentially, due to the overabundance of ONP, the real market value of this postconsumer paperstock is zero.

Virtually no grade was left unscathed by the deterioration in recycled fiber markets during 1989 and 1990. However, the higher grades tended to drop the most because they had risen the highest during the market upturn of 1987-88, while the lower grades had shown only modest

U.S. WASTEPAPER EXPORTS, 1970-89

(short tons)

Year	News	Corrugated	High-grade deinking	High-grade pulp substitutes	Other	Total
1989	829,455	2,695,543	812,043	401,549	1,340,570	6,079,161
1988	1,008,664	2,277,166	841,696	627,757	884,835	5,640,118
1987	869,743	1,920,719	525,860	365,419	736,691	4,418,432
1986	765,832	1,524,897	446,966	312,239	674,940	3,724,874
1985	624,644	1,310,852	290,486	178,975	879,042	3,283,999
1984	540,459	1,263,043	296,274	251,200	917,201	3,268,177
1983	461,153	993,436	224,701	189,578	750,463	2,393,381
1982	444,093	886,655	140,349	163,790	492,131	2,127,018
1981	425,060	991,115	130,319	192,192	473,863	2,212,549
1980	424,864	1,208,609	176,442	204,881	649,395	2,664,191
1979	336,138	960,369	134,959	153,950	647,686	2,233,102
1978	366,005	576,653	93,307	92,452	471,032	1,599,449
1977	644,038	591,529	301,273[1]	—	341,526	1,878,366[2]
1976	244,118	426,104	300,096[1]	—	302,418	1,272,626
1975	164,294	333,631	176,145[1]	—	187,318	861,388
1974[3]	—	—	—	—	—	1,307,000
1973[3]	—	—	—	—	—	683,444
1972[3]	—	—	—	—	—	415,033
1971[3]	—	—	—	—	—	419,046
1970[3]	—	—	—	—	—	408,000

1. Includes "high-grade pulp substitutes."
2. Subsequent revision by Census changed total to 1,544,000 tons, due to errors reported in exports to Greece and Canada; revision does not indicate which wastepaper grades are affected by the change.
3. No grade designations prior to 1975.

Source: Dept. of Commerce data as reported by the Institute of Scrap Recycling Industries.

improvements or, like ONP, had either leveled off or fallen previous to the downturn.

Normally, high grades suffer least during fluctuations in market conditions. With the inexorable increase in market pulp prices during 1987-88, many mills stepped up their use of pulp substitutes such as hard white envelope cuttings (HWEC) and hard white shavings (HWS). When the price of pulp substitutes became too high, mills that could traded down to deinking grades such as CPO, manifold white ledger (MWL), and manifold colored ledger (MCL).

However, with the fall of the woodpulp market in late 1989 and through 1990, pulp substitute prices also began to tumble. In most regions of the country, prices dropped each month from second-quarter 1989 through third-quarter 1990. From mid-1989 to mid-1990, HWS prices plunged about 23% in New York City, 16% in Chicago, 17% in Atlanta, and 14% in San Francisco and Los Angeles.

Deinking grades exhibited the strongest demand of any grade of paperstock in 1989. This trend was expected to continue through 1990. Mills are trading down from higher-priced pulp substitutes to deinking grades, especially as technology improves and new laws are favoring postconsumer grades of recycled fiber.

CPO markets have been one of the most challenging in recent years, though. With the growth in laser printers, fewer mills are able to use CPO. Laser printers burn ink into the paper, making deinking difficult with conventional flotation and chemical processes. Some companies claim to have developed methods for dealing with laser-printed CPO, but they keep the details classified. Kimberly-Clark Corp. operates a pilot plant for this purpose at its tissue mill in Memphis, Tenn., but the company will not discuss the project. Industry sources believe Fort Howard Corp. also has such technology in place.

In the secondary fiber business, technology provides an very important edge. Mills that can remove certain contaminants such as hotmelt glues and laser printing can use a wider variety of paperstock grades and hedge fluctuations in supply/demand and prices. In addition, they can make a higher-quality product using lower-cost raw material.

1988 CANADIAN WASTEPAPER USE, BY GRADE

(000 metric tons)

Grade	Mixed	Boxboard	Newspapers	Corrugated	Deinking, other	Total
Tissue	1.6	—	0.8	1.6	34.4	38.5
Newsprint	—	—	*	—	*	*
Other paper	—	—	1.4	0.3	0.3	2.0
Linerboard	—	—	—	19.9	4.4	24.4
Corrugating medium	—	—	—	26.2	2.5	28.7
Boxboard	4.6	11.3	13.3	48.4	15.5	93.2

*Would disclose individual company data.
Source: Canadian Pulp & Paper Assn.

Contrary to other sectors of the pulp, paper, and paperboard industry, the consumer of wastepaper usually sets the price. When mills want to generate more paperstock due to projected shortfalls in supplies, they raise prices and cause generators to take interest in the market again. Conversely, prices are cut when the intention is to slow the flow.

The exception occurs during a shortage, when demand picks up faster than additional supplies can be generated. This does not happen often, however, as mills have become increasingly more adept at spotting upcoming changes in the marketplace. In addition, more primary producers are themselves getting involved in recycling, integrating their operations fully or partially to eliminate or reduce the need for a middleman such as a dealer or broker of paperstock.

Secondary fiber prices react quickly to changes in the entire industry and, as such, are considered a bellwether of future market conditions. Most industry experts think wastepaper prices will continue to vacillate suddenly and sharply unless supplies are substantially reduced by construction of waste-to-energy facilities throughout the country or by other methods that would limit supplies.

EXPORTS/IMPORTS

The U.S. is by far the world's largest exporter of wastepaper. In 1989, U.S. paperstock exports reached an all-time high of 6.3 million short tons—a 6.0% increase over 1988. Wastepaper imports into the U.S., though, are relatively insignificant. In 1989, the U.S. imported just 172,575 tons of wastepaper. Of this, Canada supplied 164,217 tons.

The largest consumers of U.S. paperstock in 1989 were Rep. Korea, 1.231 million short tons; Taiwan, 1.169 million tons; Mexico, 1.075 million tons; Canada, 610,799; Japan, 530,445 tons; Spain, 243,562 tons; and Italy, 222,066 tons. These seven countries accounted for 87.7% of U.S. wastepaper exports in 1987, 84.7% in 1988, and 80.6% in 1989. The declining importance of the seven largest importers of U.S. wastepaper suggests that the world market for U.S. wastepaper has been broadening, according to API.

U.S. wastepaper exports have grown rapidly during the past two decades, rising from 408,000 short tons in 1970. Aside from the record reached in 1986, each of the years after 1982 marked all-time highs. In 1982, however, exports dipped 3.8% due to a worldwide recession, but they jumped 12.5% in 1983 to 2.393 million short tons.

The strongest gain in U.S. wastepaper exports in 1989 was registered by ONP, up 19.8% to 1.28 million tons. Over two-thirds of this increase originated in the Far East, principally Rep. Korea and Taiwan. U.S. exports of ONP to Italy, Spain, and the

Netherlands also posted substantial gains.

Exports of OCC, a category that also includes unbleached paper and paperboard, rose 17.6% to 2.9 million tons. Over half of last year's tonnage gain went to Mexico, possibly reflecting the startup of a new linerboard machine. Thus, Mexico became the largest importer of OCC from the U.S. in 1989. OCC exports to the Far East also rose briskly last year.

Exports of mixed papers grew 3.8% in 1989, while exports of high-grade deinking papers and pulp substitutes plunged 20.6%. To some extent, the sharp drop-off may have reflected grade reclassification that took place in connection with shifting to the Harmonized System. Strong domestic demand for the high grades may also have resulted in smaller volumes available for exports. The sharpest drop in exports of high-grade wastepaper was to Mexico and the Far East.

Global demand for U.S. wastepaper should continue to grow. Not only is the relative high quality of U.S. long-fiber wastepaper an attraction, but recovery rates around the world are already reaching their limits while recycled-fiber capacity continues to grow. API projects that world demand for U.S. wastepaper could reach 11 million tons or more by 1995, about 5 million tons more than 1989's record level.

CANADA'S TRADE AND USE

Canada remains one of the top five export customers for U.S. paperstock, but its ranking has dropped from second to fourth place since 1980. It is still the chief supplier of U.S. imported wastepaper; however, the import market meets less than 1% of U.S. mills' secondary fiber requirements. Canada, on the other hand, represents about 5% of the export market for U.S. paperstock. The U.S. exported 284,379 short tons of wastepaper to Canada in 1989.

Canadian mills have increased their use of recycled fiber, and that trend will continue through the 1990s. Canadian recyclable paper consumption rose steadily between 1975 and 1988 to 1.811 million metric tons, according to CPPA. Of this amount, 924,081 tons were container grades, 391,453 tons were pulp substitutes and other grades, 289,970 tons were news grades, 120,616 tons were mixed papers, and 84,596 tons were boxboard cuttings.

In a 1990 study done by Hatch Associates Ltd. for Forestry Canada and Environment Canada, it was found that Canada's recovery of wastepaper was just 23.3% and its utilization rate was only 11.4%. The low cost of Canadian virgin fiber and energy, the relative distance between recyclable fiber sources and producing mills, and the historical inability to produce a recycled product comparable to a virgin-fiber product have all contributed to low Canadian recycled fiber usage, according to the Hatch report.

Commercially driven demand for ONP in Canada has been limited to Quebec & Ontario Paper Co., which uses ONP to make 50% recycled-fiber newsprint at its mill in Thorold, Ont. However, ONP and old magazine demand will soon pick up with the startup of a new 100% recycled-fiber newsprint machine at Atlantic Packaging Products Ltd.'s mill in Whitby, Ont., in January 1991.

Recycling, though, is more extensive in other sectors of the Canadian paper industry. Fifty-two of the country's 110 mills use wastepaper for all or part of their furnish, according to CPPA. Most of these are located in the densely populated London, Ont., to Quebec City, Que., corridor. They use a variety of wastepaper grades to produce boxboard, tis-

CANADIAN WASTEPAPER CONSUMPTION

(metric tons)

Year	Container	News	Boxboard cuttings	Mixed papers	Pulp Substitutes and other grades	Total
1988	924,081	289,970	84,596	120,616	391,453	1,810,716
1987	905,058	239,024	67,227	121,073	363,282	1,695,664
1986	863,954	203,209	72,270	109,690	346,094	1,595,217
1985	752,499	199,883	73,156	94,326	322,485	1,442,349
1984	750,033	206,232	82,603	101,115	323,485	1,463,468
1983	673,828	197,597	78,998	88,773	291,533	1,330,729
1982	606,680	158,188	72,045	60,959	251,928	1,149,800
1981	688,843	150,362	78,991	59,090	232,727	1,210,013
1980	670,385	151,707	79,488	60,943	229,698	1,192,221
1979	613,176	151,613	83,183	74,184	239,339	1,161,495
1978	579,762	120,618	74,016	75,169	231,942	1,081,507
1977	507,437	91,885	62,521	54,793	183,428	900,064
1976	432,945	80,747	60,750	43,123	161,522	779,087
1975	326,951	66,218	52,250	49,738	114,783	609,940

Source: Canadian Pulp & Paper Assn.

sue paper, containerboard, and some newsprint and printing/writing grades.

Further expansions will increase demand for recycled fiber. Both in the U.S. and Canada, virtually every manufacturer has looked at the feasibility of increasing recycled-fiber production. Most are deciding to add recycled-fiber processing facilities to existing mills, where it is more practical. Very few are building greenfield recycled mills.

Some, however, are being more conservative. They are choosing to buy recycled fiber from existing market deinked pulp mills like those operated by Ponderosa Fibers of America Inc. and Cascades Inc. or to sign long-term supply agreements with new mills being planned by others. Fletcher Challenge Canada Ltd. and MacMillan Bloedel Ltd., for instance, plan to buy deinked pulp from a new mill being built in Coquitlam, B.C., by Newstech Recycling Inc.

By the end of 1991, Canadian mills will be able to supply significant volumes of recycled-content newsprint, according to Brian McClay, director of Trade Affairs for CPPA. Increased recycling activity is also anticipated in other sectors of the Canadian paper industry, such as printing and writing grades.

RESTRUCTURING

As a result of all the emphasis on recycling and increased recycled-fiber production, the wastepaper business itself is consolidating into bigger operations. Some of these can now accomplish everything from garbage pickup, through paperstock buying and selling, to the production of recycled paper and paperboard. This trend has surfaced just since 1989, and many expect it to continue.

More and more paper companies began in 1989 to look for long-term supplies as uncertainty about adequate recycled fiber availability came into question with the plethora of announced recycled paper and paperboard expansions. They began to sign long-term agreements with paperstock dealers and brokers but, in recent months, have integrated their supply lines further back to the source—as far as the garbage itself.

In July 1990, Stone Container Corp. announced it had struck a deal with Waste Management of North America Inc., the largest waste hauler in the U.S., to form a joint-venture wastepaper marketing company. Stone would market the wastepaper that Waste Management would collect. Earlier in 1990, Waste Management acquired U.S. Recycling Industries, a large U.S. wastepaper collector, sorter, and baler.

In June 1990, Weyerhaeuser Co. signed an agreement with Browning-Ferris Industries, the second largest waste hauler in the U.S., to provide Weyco's Secondary Fiber Div. with about 120,000 tpy of recycled fiber.

Among the other companies that have made similar arrangements is Canadian Pacific Forest Products Ltd. with Laidlaw Waste Systems Inc., a large Canadian garbage collector.

Paper companies have been integrating more into the paperstock business since the late 1980s, but never as quickly as in the past few months. Jefferson Smurfit Corp. has operated its own secondary fiber procurement division for several years. The operation, which was recently restructured and renamed Smurfit Recycling Co., claims to be the largest reclamation and recovery operation in the U.S. It expects to collect in excess of 4 million tons of wastepaper in 1990 and either to use the fiber in its own mills or to resell it to other domestic and overseas consumers.

Other North American paper companies that handle their own recycled fiber procurement and marketing divisions include Cascades, Domtar Inc., Garden State Paper Co., Quebec & Ontario Paper, Sonoco Products Co., Southeast Paper Manufacturing Co., and The Newark Group.

Wastepaper dealers and brokers—which have long been the backbone of the wastepaper collection and distribution business—are concerned that these new deals could put them out of business. In addition, municipalities themselves are setting up programs to market their recyclables, and mills are finding it cheaper to bypass the dealers and brokers and go directly to these government agencies.

However, other market observers feel confident that brokers and dealers will still have a place in the market, especially for the higher grades such as pulp substitutes and deinking grades that municipalities and waste haulers find more difficult and less profitable to handle with a large-scale, commodity-oriented approach.

PULPING

Pulping wastepaper is significantly easier than pulping wood. The process involves the separation of the web or sheet into individual fibers. The removal of any ink is considered a separate process and is called deinking.

A pulper is generally used in pulping secondary fiber. It is filled with water, and wastepaper is added, usually from a conveyor belt, until a consistency of at least 5% to 6% recyclable paper is reached. A spinning rotor in the bottom of the pulper tears the paper into smaller pieces. These pieces, in turn, rub against each other to further break down the fibers. Stock removed from the pulper usually passes through a screen to remove pieces that have not been broken down sufficiently.

Chemically treated or coated wastepaper, which may be more difficult to repulp, requires further processing. Usually the water in the pulper is heated to 65°C (150°F), and chemicals such as sodium hydroxide or soaps and dispersing agents are added.

Deinking. In the deinking operation, ink is removed from the fiber by the combination of mechanical and chemical action in the pulper. Washing systems remove the ink once it is in suspension. With ink particle size below ten microns and/or with high-ash-content furnishes, washing offers the highest efficiency.

With the evolution in printing—xerography, laser printing, UV cured inks—flotation deinking systems are being used more now in North America. And where both ink and ash removal are required, a combination washing and flotation system is advised.

One of the advantages with washing systems is in deinking waste-based readily, to a point where some of the ink particles are so small that they cannot easily be separated from the pulp fibers.

The chemistry in each system differs. Washing requires a dispersion approach and flotation requires a collector approach. Dispersion and collector chemistries are quite different. Fortunately, chemical suppliers have developed chemical formulas balancing the needs of both, and suppliers continue to improve methods of washing and flotation.

Flotation is a process whereby air is injected into the system, creating bubbles that capture the ink particle and rise to the pulp slurry surface as foam. The foam is then skimmed off the top, removing the ink with it.

Dispersion devices have been developed that, with a combination of thermal and mechanical energy, break residual ink or stickie contaminants down to ultrafine particle size. The particle size of the stickies becomes small enough to greatly reduce the chance of plugging machine forming fabrics. Wet-end chemistry helps to prevent these particles from adhering to each other.

For lower-brightness systems generally involving mechanical pulps, a lower-consistency sodium hydrosulfite bleach stage is often sufficient. Where more brightness is required, a high-consistency bleaching stage is added.

The peroxide stage, followed by a sodium hydrosulfite stage, provides high brightness along with the color stripping capabilities of the hydrosulfite. Another reductive bleaching agent showing promise is thioureadioxide.

Contaminant removal. Contaminants also pose a problem in recycled-fiber pulping systems. Heavy contaminants include metals (nuts, bolts, wire, soda cans, staples) as well as sand, rocks, and glass. Light contaminants include plastics, Styrofoam, waxes, hotmelt glues and adhesives, pressure-sensitive adhesives (stickies), and wood (from skids).

Contaminant-removal systems are usually designed so that the larger contaminants are removed first, getting them out of the system before they are broken down into smaller particles that will be more difficult to remove. With a properly designed contaminant-removal system, 99% or more of the debris found in such grades as OCC can be removed.

Pieces of equipment used in such a system include the following:

- Hydrapulper—used to slush up the incoming bales of OCC. This eliminates larger contaminants as they pass through an extraction plate with 1/2-in. or 5/8-in. drilled holes.
- Pulper washing systems—these detrashing systems continuously remove large debris so that the pulper remains unclogged.
- Centrifugal cleaners—remove contaminants by centrifugal action using a specific gravity that is based on the contaminant. This can range from high-density cleaners used to remove nuts and bolts to through-flow cleaners used to remove small pieces of plastic, stickies, and waxes.
- Screens—use either holes or slots to separate the good fiber from the contaminants and are usually installed in multiple stages to prevent excessive loss of good fiber. They are usually used in a combination of coarse screens for larger pieces of debris (holes range from 0.050 in. to 0.094 in.), and fine screens for small pieces of plastic and stickies that have passed through the coarse screens (slots range from 0.008 in. to 0.014 in.).
- Dispersion equipment—used to break up the remaining debris so that it can be hidden in the sheet.

CONVERTED PAPER AND BOARD PRODUCTS

The converting sector produces finished products—corrugated boxes, folding cartons, envelopes, and facial tissue—from paper and paperboard. The average converting plant is small, usually employing fewer than 100 persons and annually grossing about $10 million or less. However, the total converting sector of the industry is not small. In fact, when sales of all converting segments are combined, they nearly equal the total value of all paper and board manufactured.

Because the converting sector is large and complex, this chapter describes the subject in only a general way. Often it is more practical to discuss converting under the primary manufacturing to which it relates; therefore, the reader is referred to sections covering primary paper or board grades for more information. The following converted products are discussed here and in other specified sections:

- Corrugated containers and solid fiber boxes (refer to Linerboard and Corrugating Medium sections)
- Setup paperboard boxes (Recycled Paperboard section)
- Fiber and composite cans, tubes, and drums (Recycled Paperboard section)
- Folding boxboard (Recycled Paperboard section)
- Sanitary food containers (Bleached Board section)
- Molded pulp products (Pulping Processes section)
- Bags and sacks (Packaging and Industrial Converting Papers section)
- Envelopes (Paper Introduction section).

The following converted products, though not discussed in the text, are included in the statistical data in this section:

- Die-cut paper and paperboard
- Coated and laminated paper products
- Packaging tapes and labels
- Stationery products
- Converted paper products, not classified.

Although the printing and publishing industries are not converting industries, they are closely allied to the paper industry; data on these industries are summarized in the introduction to the Paper Grades section.

CORRUGATED CONTAINERS

Corrugated containers are the workhorses of the packaging industry. More goods and products are shipped in corrugated containers than in any other packaging system. Nearly 90% of industrial and consumer goods transported in the U.S. are shipped in some form of corrugated or solid-fiber container, cushioning, or partition. The other major use for corrugated products is printed retail displays.

Corrugated containers are produced from two paperboard grades—linerboard and corrugating medium. Corrugated board is produced on a corrugator that simultaneously flutes the corrugating medium and bonds linerboard to the

PACKAGING SALES BY PACKAGING MATERIALS

	Shipments (billion $)	% of total
Total packaging sales	$53.7	100.0%
Paper and paperboard	27.3	50.8
Corrugated containers	15.6	29.1
Folding cartons	5.5	10.2
Paper bag/sacks	2.3	4.3
Sanitary food containers	1.9	3.5
Others	2.0	3.7
Metal	11.3	21.1
Cans	10.3	19.2
Drums and others	1.0	1.9
Other materials	15.1	28.1
Glass	4.5	8.4
Flexible	4.0	7.4
Plastic	3.8	7.1
Wood and textile	0.8	1.5
Others	2.0	3.7

Source: Bureau of the Census, 1987 Census of Manufactures.

U.S. CONVERTED PRODUCTS INDUSTRY VALUE OF SHIPMENTS

(million $)

CONVERTED PAPER PRODUCTS

Year	Total	Sanitary paper products[1]	Bags and sacks[2]	Paper coated, laminated	SIC 2675 Die-cut paper and board	SIC 2679 Miscellaneous converted products[3]	SIC 2677 Envelopes	SIC 2678 Stationery and tablets	Pressed and molded pulps
1989e	$41,048	$14,055	$9,212	$8,625	$2,035	$3,970	$2,813	$1,385	$338
1988e	38,621	12,634	8,218	7,919	n.a.	n.a.	n.a.	n.a.	n.a.
1987	35,550	11,593	7,123	7,334	1,739	3,672	2,620	1,229	240
1986	32,248	10,965	5,954	6,632	1,939	3,082	2,270	1,168	238
1985	30,710	10,338	5,614	6,340	1,890	2,994	2,172	1,128	234
1984	29,925	9,772	5,388	6,452	1,880	2,928	2,108	1,161	236
1983	26,563	8,616	5,081	5,314	1,798	2,604	1,875	1,058	217
1982	25,044	8,374	4,773	4,903	1,605	2,436	1,752	959	242
1981	26,111	8,346	5,613	5,146	1,677	2,598	1,601	892	238
1980	23,705	7,636	5,215	4,688	1,454	2,187	1,464	836	225
1979	21,081	6,615	4,579	4,086	1,468	2,043	1,304	766	220
1978	18,447	5,591	3,926	3,746	1,189	1,901	1,121	747	226
1977	16,454	4,921	3,482	3,392	1,058	1,698	991	652	240
1976	12,558	4,187	1,936	2,653	983	1,267	843	510	219
1975	11,086	3,647	1,760	2,198	882	1,107	806	483	203
1974	9,886	3,041	1,913	2,350	884	1,073	813	486	202
1972	7,297	1,982	1,186	1,650	646	662	558	421	162

BOXES AND CONTAINERS

Year	Total	Corrugated containers[4]	Folding boxboard	Sanitary food containers	Fiber cans, tubes, drums	Setup paperboard boxes
1989e	$31,268	$19,458	$6,879	$2,643	$1,794	$494
1988e	28,814	18,067	6,284	2,382	1,621	460
1987	25,904	16,073	5,687	2,193	1,517	434
1986	22,929	13,335	4,466	2,982	1,615	531
1985	21,926	12,579	4,347	2,847	1,640	513
1984	21,968	12,719	4,327	2,750	1,679	493
1983	19,906	11,045	3,980	2,686	1,643	552
1982	18,578	10,303	3,744	2,556	1,490	485
1981	18,917	10,760	3,557	2,691	1,496	413
1980	17,193	9,651	3,277	2,430	1,370	465
1979	15,895	8,976	2,950	2,328	1,297	434
1978	14,528	8,030	2,884	2,086	1,119	409
1977	13,350	7,351	2,579	2,048	1,011	361
1976	11,662	6,530	2,162	1,744	1,000	406
1975	10,476	5,733	1,875	1,616	988	344
1974	10,489	5,867	1,807	1,506	909	400
1972	7,913	4,197	1,372	1,381	620	343

e = Estimate.
n.a. = Not available.

[1] Includes drapes, sanitary napkins, tampons.
[2] Includes plastic bags and sacks.
[3] Includes wallcovering, gift wrap, industrial products, novelty items, etc.
[4] Includes solid-fiber containers.

Source: Bureau of the Census, *Pulp & Paper* estimate (1988).

top and bottom of the medium. The corrugator also cuts the board to size and may score it in one direction. Before the blank can be formed into a box, score lines must be added in the other direction, and slots must be cut to form flaps that can be folded. Promotional information, specifications, and handling instructions must also be printed. The machine that most often performs these multiple steps is a flexo-slotter-folder-gluer.

The most common form of corrugated board is single wall (one layer of medium between two layers of linerboard). About 90% of boxes in the U.S. are made from single-wall board. Corrugators can also produce single face (one layer of medium bonded to a single layer of liner), which is used mainly for wrapping and interior packing. Heavier-duty boxes can be made from double wall (two layers of medium and three linerboard facings) and triple wall (three medium layers and four liner facings).

Flutes have five standard sizes: A, B, C, D, and E. Flute size is determined by the size of the corrugating roll's teeth and is measured in flutes per linear feet. The larger flutes generally offer greater stacking strength, and the smaller flutes offer greater puncture resistance. Most converting plants produce the intermediate-size B- and C-flutes. A-flute is the largest, but it is not widely used. E-flute is the smallest and is somewhat of a specialty because it can be run on folding carton equipment. It also offers the smoothest printing surface because its closely spaced flutes prevent "wash boarding" of the outer liner. E-flute is the preferred choice for point-of-purchase retail displays. Choice of flute type is dependent primarily on strength (crush strength) and packaging requirements.

Corrugated boxes are manufactured in several different styles, the most common of which is the regular slotted container (RSC). More specialized types of boxes include bag-in-box for liquids and powdered products, bulk bins that can carry products weighing up to 3,000 lb, and trays for produce. Solid-fiber boxes, the first fiber boxes to replace wood packaging, account for only about 0.4% of industry shipments. Solid-fiber sheets are constructed by gluing or laminating two or more plies of paperboard together. A new and growing solid-fiber application is slip sheets, which are replacing wooden pallets for forklift loads.

Corrugated boxes that are used in interstate shipping in the U.S. are subject to certain regulations. A schedule of freight classifications has been established by railroads and common motor carriers and includes rules governing the acceptance of freight packaging in transportation. Among other things, Railroad Rule 41 and Motor Carrier Item 222 establish 1) bursting strength of containerboard used to make boxes and 2) weight of facings for boxes used to carry different products. For example, a box that has a 65-lb gross weight must have 84 lb/1,000 ft^2 of facings; two 42-lb facings would normally be used. Failure of the shipper to comply with these classifications could lead to penalties such as higher transportation charges, refusal of the shipment by the carrier, or rejection of payment for a freight claim. These classifications are currently being reviewed by shippers and regulators.

Recent trends. More than 70% of all corrugated packaging materials are used in the manufacture of shipping containers, and corrugated boxes account for about one-third of the total value of all domestic paper and nonpaper packaging sales. For the fourth consecutive year, the volume of shipments of corrugated and solid fiber boxes and related products climbed in 1989. Corrugated box shipments in 1989 were at a record-high 313 billion ft2—up 1.6% from 1988. This followed a 3.6% increase in 1988, a 4.9% gain in 1987, and a 6.1% increase in 1986.

Corrugated box shipments during the past decade grew

U.S. PRICE INDEXES FOR MAJOR CLASSES OF CONVERTED PRODUCTS

(1982 = 100)

Year	Converted paper and paperboard products	Sanitary paper products and stock	Paper bags and shipping sacks	Paper boxes and containers	Composite cans
1989	132.0	125.3	155.9	130.3	134.8
1988	125.8	117.2	149.0	125.6	126.7
1987	114.7	109.1	125.9	115.4	117.0
1986	109.4	108.1	116.9	107.8	115.1
1985	108.9	106.6	111.9	108.8	114.7
1984	106.4	103.4	110.5	105.7	110.7
1983	100.4	102.1	99.0	99.5	106.5
1982	100.0	100.0	100.0	100.0	100.0
1981	97.9	98.2	n.a.	97.7	91.4
1980	90.2	91.9	93.6	89.4	84.9
1979	79.4	79.1	83.7	79.1	75.9
1978	70.5	71.7	72.5	69.9	70.3
1977	66.8	66.9	65.2	67.1	65.1
1976	64.3	60.6	62.1	66.0	60.0
1975	61.2	55.0	59.2	63.3	56.1
1974	54.8	44.0	52.6	58.5	48.1
1973	46.0	35.3	45.4	49.9	41.0
1972	43.0	34.2	40.9	46.4	38.8
1971	41.5	33.8	38.0	44.7	37.6
1970	40.8	32.5	40.6	43.3	36.3

n.a. = Not available.
Source: Bureau of Labor Statistics.

at about a 2.5% average annual rate. The fastest growth was in the Southeast, Southwest, and West, and the slowest growth was in the Northeast and Midwest, reflecting the movement of industry to the so-called Sun Belt region. The Southeast's share of total U.S. box shipments increased from about 10.1% in 1960 to 18.9% in 1989, while the Northeast's share dropped from 27.3% to 17.5%. The East Central region also showed a major decline, with its share dropping from 21.4% in 1960 to 14.2% in 1989.

RANKING OF U.S. CORRUGATED CONTAINER PRODUCERS BY CAPACITY

	Company	Number of U.S. plants	1988 capacity (billion ft^2)
1.	Stone Container	86	43.0
2.	Georgia-Pacific/GNN[1]	53	34.2
3.	Weyerhaeuser	43	28.3
4.	Smurfit/CCA	49	28.0
5.	International Paper	35	23.0
6.	Temple-Inland	31	20.2
7.	Willamette	19	14.0
8.	Union Camp	24	12.0
9.	Gaylord Container	21	11.5
10.	Boise Cascade	22	10.0
11.	Packaging Corp. of America	27	9.1

1. Georgia-Pacific acquired Great Northern Nekoosa in 1990.
Source: *Pulp & Paper* estimates.

The slower growth in corrugated box shipments in 1989 was instrumental in moderating the steep upward trend in corrugated board prices seen in 1987-88. Frequent regional discounting and price hike rollbacks were implemented under heavy pressure from independent boxmakers. Despite the slowdown in raw material cost pressures, box prices increased only about 2% in 1989. In mid-1989, containerboard inventories reached about 2.5 million tons. Over 90% of this inventory was held at the box plants, and the remainder at the board supplier mills. Although the average supply had slowly declined during the first half of 1989 to a 5.5-week supply, containerboard inventories were on the rise during the third quarter as a result of slowing demand in the second half of the year. Inventories at the end of 1989 jumped to a 5.9-week supply.

Industry structure. Corrugated containers are produced at two types of manufacturing plants: corrugated container plants (corrugator plants) and sheet plants. Both types of plant make corrugated container blanks, but only the corrugated container plant has a corrugator. Sheet plants purchase rolls or sheets of corrugated paperboard from corrugated container plants, and they cut and print these into container blanks.

U.S. CORRUGATED PRODUCTION AND INVENTORY

	Production[1] (billion ft^2)			Inventory[3]	
Year	Single wall	Double and triple wall	Total[2]	Tonnage (000 short tons)	Weeks of supply
1989	306.1	28.5	336.3	2,553	5.4
1988	299.3	28.8	329.5	2,486	5.7
1987	289.4	27.6	317.0	2,237	5.8
1986	274.6	26.0	300.5	2,549	7.1
1985	258.9	24.5	283.4	2,882	8.4
1984	256.2	24.7	282.0	2,437	7.2
1983	240.3	22.7	264.2	2,584	8.9
1982	224.2	20.9	246.3	2,729	9.4
1981	229.8	22.1	253.0	1,984	6.2
1980	229.1	21.7	251.9	1,979	6.2
1979	236.7	23.2	261.1	1,961	5.8
1978	232.8	22.3	256.4	2,436	7.2
1977	217.2	20.4	238.8	2,527	8.1
1976	207.9	18.6	227.8	2,185	7.2
1975	186.2	15.9	203.2	2,323	8.2
1974	203.4	19.1	224.1	1,595	4.7
1973	216.8	20.2	238.5	1,603	5.1
1972	200.9	17.6	220.1	1,639	5.7
1971	183.8	15.1	200.3	1,879	7.0
1970	177.1	14.1	192.7	1,760	6.5

1. Production includes waste and trim before fabrication.
2. Total includes single-face production which has averaged around 1.3 to 1.5 billion ft^2/year.
3. Inventory of linerboard, corrugating medium, and filler board at box plants and paperboard mills based on inventory at Jan. 1 of each year.
Source: Fibre Box Assn.

In 1989, there were 1,566 U.S. manufacturing plants in operation, of which 642 were corrugated converters and 924 were sheeting plants, which manufacture boxes from board purchased from the corrugaters. In the last several years, the number of sheet plants has grown slightly because of the lower capital costs and technology required to build them. Also, some corrugator plants were converted exclusively to sheet plants to consolidate manufacturing operations for large producers. Nevertheless, sheet plants in 1989 accounted for only about 14.2% of total corrugated box shipments, compared with 11.7% in 1970.

The corrugated container industry is highly integrated with paperboard manufacturing. Integrated producers are companies that operate either a linerboard or corrugating medium mill and a corrugator plant.

These companies account for about 75% of total U.S. corrugated box shipments. The merger of Georgia-Pacific Corp. and Great Northern Nekoosa in early 1990 will have a long-term impact on industry consolidation. The two companies together operate 51 corrugator plants and two sheeting plants that consumed 2.4 million tons of containerboard in 1989 and shipped about 34.2 million ft². In the third quarter of 1990, G-P was negotiating the sale of two containerboard mills and 19 corrugated box plants to Packaging Corp. of America.

Nonintegrated producers generally operate sheet plants, and they are dependent on integrated producers for their raw materials. Consequently, independent producers are often at a competitive disadvantage, particularly when containerboard is in tight supply. In 1989, however, independents firmly resisted linerboard price increases announced by the major integrated companies.

Although the industry prefers to export containerboard, especially linerboard, rather than bulky corrugated containers, exports of corrugated boxes have increased in recent years. In 1989, corrugated box exports totaled an estimated $196.5 million, up about 11% in dollar value from the 1988 level.

U.S. linerboard exports were valued at close to $1 billion. Mexico and Canada purchase about 80% of U.S. corrugated box exports for shipping their manufactured goods.

Unlike paperboard mills that operate continuously, corrugated container plants operate between one and two shifts a day, generally on a five- to six-day week. Production units vary in size, with an average of 94 employees per converting plant and ten employees per sheet plant. They are located close to their markets, principally large industrial and urban centers.

As mentioned earlier, sharply rising raw material costs and lagging box prices have squeezed the average box plant's profit margin. This has forced most container plants to improve productivity, and the results have been dramatic. Shipments per week per employee have increased steadily from 46,600 ft² in 1970 to 85,800 ft² in 1989—an increase of 80%. During this period, the total number of employees in the industry declined from 74,100 in 1970 to a low of 59,100 in 1982. Employment returned to 72,200 people in 1989. The improvement in productivity helped slow the industry's rise in unit labor costs. While total hourly payroll costs spiraled upward by 209% during this period, unit labor costs increased 68%, according to Fibre Box Assn. data.

Productivity climbed because manufacturers switched to faster and more efficient corrugators. Other printing and converting equipment improved as well. Flexographic printing and the rotary diecutter were adopted in the 1960s, and the continuous corrugator emerged in the mid-1970s. Today, new state-of-the-art continuous corrugators run at 800 to 1,000 fpm, compared with about 600 fpm for a typical corrugator in the early 1970s.

Such high-speed machines place increasing importance on moisture uniformity, mechanical roll quality, and bonding speed of liners to medium. Moisture variation in containerboard may cause warp that high-speed corrugators cannot tolerate, while roll defects may lead to costly downtime from web breaks. More U.S. containerboard manufacturers are interested in meeting uniform moisture requirements.

Changing market requirements. The trend toward stacking corrugated boxes to greater heights on pallets in warehouses has increased the demand for containers with greater top-to-bottom compression strength. This trend is being hastened by a shift from rigid metal and glass containers to plastic packaging in primary containers. At the same time, palletization has eliminated much of the manual handling of individual corrugated cases in the transportation system.

As a result, ring crush, which measures compression strength, is replacing bursting strength (mullen) as the most relevant performance requirement for corrugated board. (See Linerboard section.) Industry pressure for modifications of existing box specifications—from burst strength to compression and edge crush—has heated up. Several major containerboard producers are now marketing high-ring-crush board that offers higher strength and yield (more surface area per ton).

U.S. CORRUGATED BOX SHIPMENTS BY REGION

(billion ft²/year)

Year	Total	Northeast	Southeast	East Central	North Central	South Central	West
1989	313.4	54.9	59.1	44.5	38.5	62.6	53.7
1988	308.5	55.6	57.5	44.5	37.9	61.1	51.9
1987	297.8	54.3	54.8	43.7	35.7	58.5	50.7
1986	283.9	52.3	51.6	41.9	34.5	55.3	48.3
1985	267.5	50.1	48.0	40.3	32.7	52.1	44.3
1984	267.6	51.1	47.5	40.3	32.8	51.4	44.5
1983	252.5	50.3	44.1	37.2	31.3	47.4	42.2
1982	235.2	48.0	39.7	34.3	28.8	44.4	40.0
1981	246.2	50.1	41.7	37.6	30.0	45.2	41.6
1980	241.4	50.6	41.3	36.9	30.1	42.9	39.6
1979	250.6	53.3	41.6	41.1	31.8	43.2	39.7
1978	243.9	52.3	38.8	41.4	31.4	41.8	38.3
1977	227.2	48.3	35.2	39.8	29.6	38.6	35.6
1976	216.4	46.8	32.8	38.3	28.5	36.2	33.8

Source: Fibre Box Assn.

Both the new emphasis on compression strength and the need to reduce fiber costs were behind an industry proposal several years ago for an alternate to Rule 41. However, few permits were taken out to test the proposed alternate rule, which measures box construction on the basis of the edge-crush or short-column test. Although the new rule seemed feasible in the limited trials that were conducted, there was little economic incentive to change, according to William O. Kroeschell, vice president of product technology, Stone Container Corp. Nevertheless, an increasing number of mills, converting plants, and end users are measuring and specifying their board and finished boxes in terms of compression strength.

One method of achieving high compression strength is through chemical saturation of containerboard. This has become feasible through development of new types of saturators using chemicals such as sodium silicate and urea formaldehyde, which can also improve fire and humidity resistance in boxes. International Paper Co. (Anvil Box) and several other companies have begun to offer such chemically enhanced products. Nekoosa Packaging Corp. (Duo Corr), among others, makes a double-laminated corrugating medium with substantially higher crush resistance, bursting strength, and ring crush. Single-wall boxes with the double-laminated medium can be substituted for bulkier, expensive double-wall boxes. Laminating is done at the corrugator using polyvinyl acetate adhesive.

Improved printing surfaces. Another emerging trend is the use of high-quality printing on corrugated boxes and displays. Direct printing with either flexography or letterpress is used on more than 80% of corrugated products and is one of the least expensive printing methods. The rough surface of the linerboard limits the quality of direct print, however. Preprinting overcomes many of these problems and is now the fastest growing method. Shipments of preprinted linerboard in 1989 exceeded 6 billion ft^2, according to some estimates, or about 2% of all corrugated product shipments.

With the incorporation of colorful graphics, the corrugated box serves not only as a shipping container but also as a point-of-purchase display.

During the 1980s, 17 flexographic presses were installed by 14 companies in North America to preprint linerboard. Such preprinted linerboard offers higher-quality graphics than conventional postprinting of corrugated board. It is also less expensive than the higher-quality process of litholaminating labels. Preprint volume has grown since 1987 because major packagers of consumer goods have increasingly shifted to higher-quality preprint packaging, spurring other companies to do the same.

SUMMARY OF STATISTICS FOR CORRUGATED AND SOLID-FIBER BOX INDUSTRY

Year	Plants	Employees	Value of shipments (million $)	Capital expenditures (million $)
1989	—	112,000	$19,458	n.a.
1988	—	109,000	18,067	n.a.
1987	1,588	105,900	16,073	$468.2
1986	—	102,000	13,335	433.5
1985	—	100,000	12,579	420.3
1984	—	98,900	12,719	426.2
1983	—	96,900	11,045	248.1
1982	1,492	93,800	10,303	279.5
1981	—	97,300	10,760	271.2
1980	—	97,200	9,651	420.5
1979	—	103,700	8,976	303.0
1978	—	105,800	8,030	282.5
1977	1,472	101,500	7,351	243.3
1976	—	101,400	6,682	185.1
1975	—	94,700	5,821	207.9
1974	—	106,800	6,015	200.9
1973	—	109,700	5,230	125.0
1972	1,265	107,900	4,309	101.5
1971	—	102,700	3,668	87.5
1970	—	104,700	3,545	108.9
1969	—	105,600	3,500	161.9
1968	—	100,700	3,231	135.6
1967	568	97,100	2,960	127.7

n.a. = Not available.
Source: Bureau of the Census.

The growth of preprint has also been helped by the development of more cost-effective board substrates in North America, such as the white-top linerboard introduced by Chesapeake Corp. The main substrates currently being used for preprinting include coated kraft board, solid bleached linerboard, and mottled/unbleached linerboard. (See Linerboard section.)

Most major U.S. integrated producers now have preprint operations, including Jefferson Smurfit/CCA, International Paper, MacMillan Bloedel, Menasha Corp., Nekoosa Packaging, Stone Container, Union Camp Corp., Willamette Inc., Westvaco Corp., and Weyerhaeuser Co. Some integrated producers became involved with preprint operations through acquisitions. For example, Chesapeake purchased the Displayco Group preprint operations from Schiffenhaus Industries in 1989, and it bought Distinctive Printing & Packaging Co. in 1987. Smurfit in 1989 acquired Tri-Pak Corp., a leading point-of-purchase display manufacturer. Independent converters with preprint operations include Lux Packaging Co., Pioneer Container Corp., and Southern Container Corp. Most litho-laminated containers are produced by independent converters such as Rand Whitney Container Corp.

Future outlook. A 2.5% average annual growth rate is forecast for the dollar value of corrugated container shipments over the next five years, according to the U.S. Dept. of Commerce. This growth trend is in line with the forecast growth in constant dollar GNP, but the demand for boxes from industrial and manufacturing operations may be closer to the 1.5% growth level in 1990-91 in a period of weaker economic growth. Plastics will continue to penetrate some traditional corrugated markets. However, containerboard producers will hold their own by expanding existing market areas.

Principal market growth is expected in shipping containers and displays for paper and allied products, chemical and allied products, plastics, and electrical machinery and equipment. Industry growth will feature continued development and use of preprinted linerboard; increased use of flexography in color printing; improvements in graphic design; more computerization and automation in all phases of box plant operations; better marketing and distribution methods; modifications of existing box specifications for compression and burst strength; greater emphasis on high-strength boxes for stacking; increased use of laminated board; improved coatings, adhesives, and inks; and greater use of E-flute board in point-of-purchase displays of shipping containers.

Despite high transportation costs, significant real growth is expected in U.S. exports of corrugated products, especially to Canada, Mexico, and the Caribbean Basin. Several box plants are being established on both sides of the border to serve Mexico's growing Maquiladora industry.

FOLDING PAPERBOARD BOXES

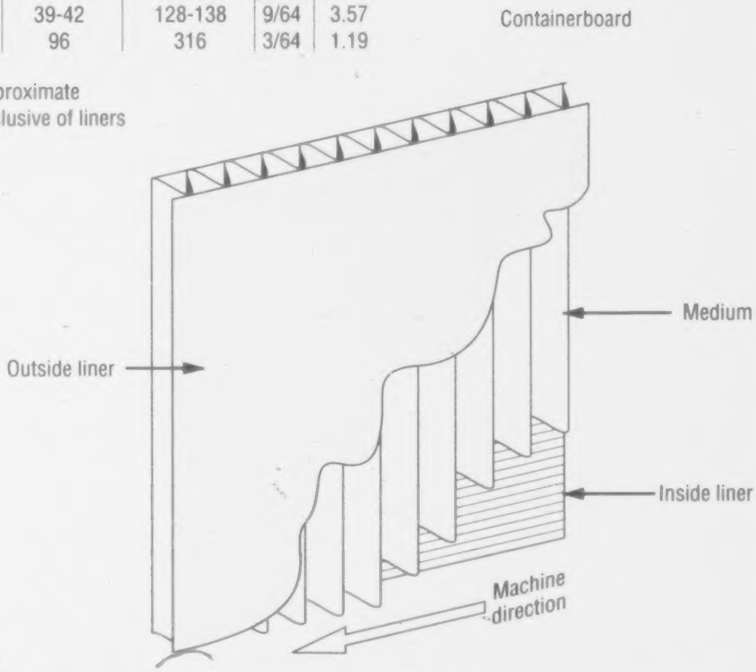
Packaging demand by the U.S. food and beverage industry is the driving force in sales of folding cartons. The country's leading manufacturers of packaged consumer goods use folding cartons to protect their primary product through shipping and distribution channels. They are also used to display the product to consumers. Folding cartons are typically die cut, printed, and shipped flat from folding carton plants to manufacturers who assemble and fill the cartons on high-speed production lines.

Paperboard grades used for folding cartons must meet technical specifications for scoring, bending, and folding without cracking or breaking; for stiffness and resistance to bulge and surface slack; and for surface smoothness for printing, embossing, or laminating. Paperboard for folding cartons is made in single- and multi-ply grades. Single-ply grades produced from virgin woodpulp are used to make solid bleached sulfate (SBS) board and solid unbleached sulfate (SUS), also called natural kraft board. SBS is mostly chosen for food and medicinal packaging because of its sanitary appearance and for cosmetic and cigarette packaging because of its superior printing and converting properties. Unbleached kraft board is used mostly for beverage carriers and other goods requiring extra strength. Multi-ply grades made from processed wastepaper are used for food and commercial products that require low-cost, minimum-protective packaging. Coatings such as kaolin clay, polyethylene, wax, and other special treatments are usually ap-

COMMON FLUTES USED IN CORRUGATED CONTAINERBOARD PRODUCTION

Flute	Number of flutes[1] per		Flute height[2]	
	Lineal foot	Lineal meter	inch	mm
A	36	118	3/16	4.76
B	51	168	3/32	2.38
C	39-42	128-138	9/64	3.57
E	96	316	3/64	1.19

[1] Approximate
[2] Exclusive of liners



Source: Metrication for the Pulp & Paper Industry, Miller Freeman Publications.

plied to boxboard to improve strength, moisture resistance, and printing surface smoothness.

Domestic folding carton shipments generally follow consumer spending and real disposable income levels, but carton sales have often lagged slightly behind fluctuations in the nation's economic growth because demand for many basic consumer goods is relatively inelastic. Although the dollar volume of folding carton shipments grew at an average annual rate of 7% between 1977 and 1988, tonnage volume grew less than 1% annually during this period. Part of the reason is the general trend toward reduced product packaging, the use of lower-density boxboard in the manufacturing process, and higher product prices.

Folding carton volume has suffered mostly because of competition from alternatives such as flexible packaging, rigid plastic containers, and E-flute corrugated board—all of which have made inroads into traditional folding carton markets during the past decade. For example, many brands of laundry detergent and disposable diapers switched to plastic packaging during the past five years. The folding carton industry rebounded somewhat with growth in new and existing end uses, especially those related to food. Food packaging accounts for about one-half of all folding carton shipments.

The folding carton industry used about 3.8 million tons of folding boxboard in 1989, according to the Dept. of Commerce and the Paperboard Packaging Council. In 1988, shipments of folding cartons totaled about 3.1 million short tons. Consumption of recycled boxboard grades increased more than the kraft grades in 1989. Shifts in the mix of boxboard consumption in recent years have been largely determined by fluctuating costs and supplies of boxboards, market pressures to use more recycled packaging, by quality improvements by recycled board manufacturers.

In recent years, a trend has developed to improve the quality of boxboard used in folding cartons. This has led to the increased use of clay-coated bleached and unbleached kraft grades. Also, low-grade recycled chipboards have been displaced by clay-coated recycled boards. In 1989, recycled grades held approximately 44.7% of the domestic folding carton market, followed by bleached kraft board with a 36.9% share, and unbleached kraft board with a 18.4% share, according to the American Paper Institute.

A significant discrepancy exists between API, the Dept. of Commerce, and the Paperboard Packaging Council concerning the total amount of paperboard used in the folding carton industry. API said paper mills produced over 5 million tons of folding boxboard for U.S. consumption in 1989. API also said mills produced an additional 1.4 million tons of paperboard for domestic milk carton and disposable food service products in 1989, which are not included in the folding carton total. Foreign exports account for another 863,000 tons of boxboard, mostly bleached kraft board. It should be noted that folding carton plants waste about 18% of the boxboard they purchase from mills, while mills report as production some of the roll trim and rejects that are sold to wastepaper brokers. The remainder of the discrepancy is related to product definitions.

Future outlook. At the start of 1989, an estimated 490 folding carton plants were operating in the U.S., down from about 500 at the beginning of 1988, said the Dept. of Commerce. The number of plants has gradually declined during the past several years as less efficient and less profitable plants were phased out and merger activity increased. The industry's major producing region is the Midwest and North Central states, the source of about 43% of the 1989 folding carton shipments. Growth has been the highest in the West and Southeast states, however.

U.S. CORRUGATED BOX PRICE TRENDS

	Corrugated shipping containers for food/beverage[1]	National overall corrugated box price trend[2]	
Year	(Mar. 1980 = 100)	(1982 = 100)	(\$/1,000 ft^2)
1989	147.8	125.8	\$51.43
1988	143.9	123.3	50.54
1987	128.4	113.3	47.22
1986	116.6	101.6	41.27
1985	119.3	106.1	42.83
1984	115.5	107.3	43.11
1983	106.8	97.2	38.86
1982	108.7	100.0	39.60
1981	108.1	101.8	40.59
1980	100.9	94.2	37.47
1979	n.a.	83.6	33.42
1978	n.a.	74.4	29.65
1977	n.a.	74.5	29.56
1976	n.a.	75.1	29.67
1975	n.a.	73.3	28.82
1974	n.a.	67.8	26.69
1973	n.a.	54.2	21.22
1972	n.a.	47.5	18.59
1971	n.a.	46.1	17.94

n.a. = Not available.
Sources: 1. Bureau of Labor Statistics; 2. Fibre Box Assn.

LARGEST CANADIAN CORRUGATED BOX PRODUCERS IN CAPACITY

Company	Number of Canadian plants	Annual capacity (million ft^2)
MacMillan-Bathurst[1]	13	8,280
Domtar	13	6,480
Canadian Pacific Forest Products	7	3,420
Atlantic Packaging	4	2,580
Kruger	3	1,920
Crown Forest	2	1,416

[1] Joint venture between MacMillan Bloedel and Stone-Consolidated.
Source: *Canadian Paper Analyst.*

Folding carton shipments during 1990-91 should grow by about 1% annually, based on continuing strength in the basic food packaging markets. Even if domestic business activity is weak, exports of folding cartons, mainly to Mexico and Canada, should increase. In 1989, exports were estimated to have reached $88 million. Imports of folding cartons, mostly from Canada in recent years, were estimated at about $90 million in 1989.

The fact is there are only two ways to increase overall folding carton sales: either increase the sales of established products or introduce new products—or entire new product lines—where none existed before. Examples of the new product trend include packaging for microwaveable food products, computer software, and videocassettes.

Manufacturers will continue emphasizing better package design and graphics as well as tamper-resistant technology. Productivity improvements should result from better cutting and creasing equipment, higher-speed box manufacturing machinery and printing presses, better coating and gluing equipment, and infrared and ultraviolet (UV) ink-curing systems. Further automation and computerization of manufacturing, marketing, and distribution should also boost productivity.

SETUP PAPERBOARD BOXES

These specialty boxes are custom made for specific products that require good protection and high-quality ap-

CORRUGATED AND SOLID FIBER BOX SPECIFICATIONS FOR RAILROAD (RULE 41)

		Corrugated fiberboard			
		Single wall		Double wall	
Maximum weight of box and contents (lb)	Maximum inside dimensions[1] (in.)	Minimum combined weight of facings (lb/1,000 ft^2)	Minimum bursting test of combined board (psi)	Minimum combined weight of facings[2] (lb/1,000 ft^2)	Minimum bursting test of combined board (psi)
20	40	52	125	—	—
30	50	66	150	—	—
40	60	75	175	—	—
65	75	75	200	92	200
90	90	138	275	110	275
120	100	180	350	126	350
140	110	—	—	222	500
160	120	—	—	270	600
275	120	—	—	—	—

		Corrugated fiberboard			
		Triple wall		Solid fiberboard	
Maximum weight of box and contents (lb)	Maximum inside dimensions[1] (in.)	Minimum combined weight of facings[2] (lb/1,000 ft^2)	Minimum puncture test of combined board (in.-oz./in.-tear)	Minimum combined weight of component plies[3] (lb/1,000 ft^2)	Minimum bursting test of combined board (psi)
20	40	—	—	114	125
30	50	—	—	—	—
40	60	—	—	149	175
65	75	—	—	190	200
90	90	—	—	237	275
120	100	—	—	283	350
140	110	—	—	330	500
160	120	—	—	360	600
275	120	264	1,100	—	—

1. Length, width, and depth added.
2. Including center facing.
3. Exclusive of adhesives.

DISTRIBUTION OF PAPER/PAPERBOARD PRODUCTS TO MAJOR CUSTOMERS

Paperboard containers and boxes	**% of total dollar output**
Food	31.2%
Wholesale and retail	5.4
Drugs, cleaning, etc.	5.0
Paper and allied products	4.8
Eating and drinking places	4.6
Rubber and miscellaneous plastic products	4.1
Paperboard containers and boxes	3.6
Glass and glass products	2.6
Miscellaneous manufacturing	2.3
Other fabricated metal products	2.1
Other intermediate	30.3
Total intermediate	96.0
Purchases by individuals	1.4
Government purchases	1.1
Exports	1.4
Imports	-0.5
Other final demand	0.6
Total final demand	4.0
Total intermediate and final demand	100.0

Paper and allied products*	**% of total dollar output**
Printing and publishing	23.1%
Paper and allied products	17.9
Paperboard containers and boxes	12.4
Wholesale and retail	5.1
Food	5.0
Health, education, and social services	2.5
New construction	1.5
Chemical and chemical products	1.3
Rubber and miscellaneous plastic products	1.1
Business services	1.1
Other intermediate	11.8
Total intermediate	82.8
Purchases by individuals	15.5
Government purchases	3.4
Exports	5.8
Imports	-9.4
Other final demand	1.9
Total final demand	17.2
Total intermediate and final demand	100.0

* = Excludes paperboard containers and boxes.
Source: Dept. of Commerce, 1983 Input/Output Tables.

FOLDING PAPERBOARD BOX SHIPMENTS BY END USE

(million $)

	1989	**1988**	**1982**	**1977**
Wet food and frozen (including ice cream)	$645.40	$568.80	$409.50	$311.20
Dry food and produce (including pet food)	788.30	677.90	544.20	376.40
Bottled and canned beverages (including carriers)	485.70	443.80	375.00	232.00
Soaps and detergents	224.10	209.90	205.50	143.80
Tobacco	164.00	148.20	131.70	93.70
Hardware, household supplies	217.50	204.40	183.10	166.60
Candy, biscuits, crackers	357.30	314.80	230.70	155.10
Perishable bakery	270.80	236.90	186.70	140.30
Cosmetics and medicine	354.10	380.70	380.10	236.00
Paper goods (including book mailers)	312.30	293.30	191.90	127.20
Retail food carryout (boxes and trays)	250.90	225.80	114.80	77.00
All other uses	153.10	141.90	108.60	99.60
Miscellaneous	130.50	93.60	67.20	68.10
Total	**4,354.00**	**3,940.00**	**3,129.00**	**2,227.00**

Source: Paperboard Packaging Council.

pearance. The containers are produced in rigid form, in contrast to folding or collapsible boxes. They are produced from solid or combination board—also called nonbending chipboard—depending on the style of the container. Setup boards range in thickness from 0.016 to 0.065 in. and weigh 60 to 260 lb/1,000 ft^2.

Stiffness, rigidity, and strength are essential qualities. Rigid boxboard can be laminated or pasted together to form nonbending boards of greater thickness. It can be made from plain chipboard, filled newsboard, single new vat-lined chipboard, or single white vat-lined chipboard. Setup paperboard is usually made from a cheaper grade of wastepaper than folding cartons because it is not subject to scoring and bending. The finished surface is typically overwrapped with a specialty packaging paper.

After a decline in shipments of more than 5% annually between 1962 and 1982, the industry grew a modest 1.5%/year between 1983 and 1988. In 1989, an estimated 288,000 tons of mostly recycled boxboard was used in the manufacture of rigid setup boxes, according to API. Approximately 500 facilities manufactured setup boxes in the early 1960s; the number dwindled to about 175 firms by 1986. Accordingly, employment fell by almost half from approximately 20,500 in 1962 to 10,600 in 1982. The low point was reached in 1984, when just 9,300 people were working. The industry rebounded to about 9,700 in 1986.

SHIPPING SACK END-USE MARKETS

(million sacks)

End use	1989	1988	1987	1984
Seeds	170	176	149	189
Sugar	64	65	63	63
Dog and cat food	282	274	244	211
Flour and flour mix	167	163	154	140
Livestock and poultry feed	387	409	407	446
Other agriculture and food	354	367	353	335
Subtotal	**1,424**	**1,454**	**1,370**	**1,384**
Cement and mortar mix	235	239	222	169
Portland cement	82	87	96	101
Masonry cement	66	68	70	84
Insulation	22	21	23	52
Other building materials	143	154	152	149
Subtotal	**548**	**569**	**563**	**555**
Fertilizer	127	159	143	170
Plastic materials	118	128	123	132
Salt and water softeners	114	118	116	126
Other chemicals	291	323	294	333
Subtotal	650	728	676	761
Clays	123	132	118	151
Limestone	109	110	104	124
Other minerals	141	158	148	181
Subtotal	**373**	**400**	**370**	**456**
Miscellaneous	335	359	305	233
Total	**3,332**	**3,509**	**3,284**	**3,389**

Source: Paper Shipping Sack Manufacturers' Assn.

U.S. PRODUCTION OF UNBLEACHED KRAFT AND RECYCLED PAPERBOARD FOR TUBE, CAN, AND DRUM STOCKS

(000 short tons)[1]

Year	Kraft	Recycled
1989	60	1,146
1988	68	1,151
1987	65	1,124
1986	54	1,043
1985	64	1,021
1984	74	1,038
1983	99	858
1982	151	767
1981	334	808
1980	220	564
1979	232	628
1978	202	602
1977	180	680
1976	172	702
1975	145	631
1974	213	733
1973	215	763
1972	216	728
1971	159	642
1970	194	573
1969	180	527

[1] Some bleached kraft paperboard is also produced for these uses, but is not included in these data.

Source: Bureau of the Census.

END USES FOR RIGID PAPER BOXES

(% distribution)

End use	1980	1970
Textile, apparel, hosiery	4.4%	18.9%
Department stores and specialty shops	6.8	13.1
Cosmetics and soaps	5.5	6.2
Confections	12.6	7.9
Stationery and office supplies	13.5	8.2
Jewelry and silverware	9.3	3.2
Photographic	4.5	2.6
Shoe and leather	0.3	4.4
Drugs, chemical, pharmaceuticals	7.5	4.2
Toys and games	1.4	7.0
Hardware and household supplies	5.5	4.9
Food, beverages	4.3	0.8
Sporting goods	1.2	2.6
Electronics	3.6	—[1]
Educational	3.7	—[1]
Other and miscellaneous customers	15.9	9.6

[1] Listed under other and miscellaneous customers.

Source: National Paperbox & Packaging Assn.

Since the early 1980s, the industry has largely halted its downward spiral. Subsequent fluctuations in growth are attributable to U.S. economic trends and to changing disposable income and consumer spending levels.

The traditional rigid box is more expensive to produce than a folding carton, so rigid boxes are primarily used to package products sold at high profit margins, such as stationery, jewelry, toiletries, and chocolates.

In recent years, the industry has improved its competitive position by restructuring through mergers and acquisitions. It has also improved its cost-effectiveness and productivity, diversified its product mix, and entered new markets. Some producers have added folding carton plants and paperboard/plastic combinations and laminations to their product lines. In addition, new technology has enabled the industry to expand into packaging for computer software, video equipment, food and beverages, advertising specialties, cosmetics and soaps, confectionery, and products previously dominated by other packaging mediums.

Future outlook. Despite the resurgance of the rigid paperboard box industry in the late 1980s, annual production of setup boxboard has shown little growth because the industry's new technologies enable it to construct stronger boxes using lower-density boxboard. The industry has incorporated plastics and other materials to create laminates with greater strength and moisture resistance, among other product improvements. This trend will continue.

Rigid box shipments are expected to edge up about 1.5% annually during 1990-94, provided that the industry adapts packaging products to new, high-value consumer goods. In some of their traditional markets, setup boxes will be challenged by folding cartons and plastics, but they are expected to retain share in high-value specialty packaging. Growth markets are expected to include packaging for cosmetics, pharmaceuticals, confectionery, and electronics.

FIBER CANS, DRUMS, AND TUBES

Composite cans, tubes, and cores are produced by the spiral or convoluted winding of paperboard strips around a core or mandel. The paperboard can be recycled board, kraft paperboard, or semichemical board. Strength is produced by the use of two or more plies. If special barriers are required, the board is first laminated with plastics or foil or else coated with hotmelts and other specialty coatings. An adhesive such as dextrine is applied to the strips during winding. The endless formed tube is cut on a mandel to desired sizes. For composite cans, either metal or plastic caps are used to seal the ends.

The market matured in the 1980s, mainly because composite cans have not been able to penetrate new, high-volume, consumer packaging areas. Furthermore, composite cans have lost most of their market share for motor oil and frozen-juice-concentrate packaging. The composite fiber can sector now accounts for only about 30% of the industry's total value of shipments, down from 47% in 1982. On the positive side, however, industrial demand for fiber drums, tubes, and cores has remained strong. The industry's tube and core sector grew an estimated 2%, and sales of fiber drums increased about 3% in 1989.

In 1989, an estimated 1.3 million tons of recycled paperboard and 175,000 tons of unbleached kraft paperboard were used in the manufacture of tubes, cores, cans, and drums. The total value of shipments of this industry is estimated to have grown almost 2% in 1989. Growth is expected to slow to about 1% in 1990 due to the expected slower pace of industrial activity.

Sonoco Products Co., Jefferson Smurfit Corp., Caraustar Industries, and Greif Brothers Corp. dominate the industrial sector of this business, with Sonoco and Jefferson Smurfit major players in the consumer products. All but Greif Bros. are integrated producers who manufacture nearly 100% of their own paper supply. Sonoco, Greif, and Jefferson Smurfit's affiliate Container Corp. of America also produce plastic industrial drums, which allows these producers to offer a wide range of products.

Shipments of tubes and

FIBER CANS, DRUMS, AND SIMILAR PRODUCTS: SHIPMENTS AND TONNAGE BY TYPE (SIC CODE 2655)

	1987	1982	1977	1972
Fiber drums				
Product shipments (million $)	311.5	289.8	223.8	136.9
Product shipments (000 tons)	n.a.	137.4	149.4	160.1
Fiber and composite cans				
Product shipments (million $)	448.2	701.4	469.0	253.2
Product shipments (000 tons)	n.a.	212.5	210.9	216.1
Cores and tubes				
Product shipments (million $)	532.7	341.7	263.4	164.3
Product shipments (000 tons)	817.8	748.3	638.7	624.5
Paperboard cores, reels[1]				
Product shipments (million $)	48.7	48.8	36.7	31.0
Product shipments (000 tons)	29.0	41.0	63.5	79.1
Vulcanized fiber products[2]				
Product shipments (million $)	40.5	25.4	6.6	14.0
Product shipments (000 tons)	n.a.	n.a.	n.a.	34.3
Other, not specified				
Product shipments (million $)	n.a.	35.0	40.8	20.0

n.a. = Not available.
1. Includes spools, bobbins, and blocks.
2. Includes boxes, cans, tubes, drums.
Source: Bureau of the Census.

cores have shown modest growth in recent years. The largest markets for tubes are consumer and industrial packaging and shipping. Composite tubes and cores account for about 40% of the industry's shipments. The largest single market for cores is the paper industry, where they are widely used for paper mill roll cores, inner cores for towel and tissue products, and office supplies. The markets for solid fiber drums cut across industrial, chemical, and construction sectors. Fiber drums have shown surprising growth in recent years due to growth in the hazardous-waste industry.

MOLDED PULP PRODUCTS

Pressed and molded pulp goods are made in a unique wet-forming process from virgin or recycled pulp. Products include egg cartons, plates, dishes, prepackaging trays, meat boards and other food trays, fiber pipes, conduit, and fittings. After a steady decline in sales due to the growth of various plastic and polystyrene products between 1973 and 1983, the molded pulp industry has regained market position, owing largely to the growing preference for environmentally "correct" products. In 1989, sales of pressed and molded pulp products were valued at $338 million, marking the sixth consecutive year of growth.

Despite this market turnaround, the number of molded pulp producers continues to decline in the face of plastic and polystyrene competition. Most of industry capacity is held by four producers. The number of North American molded and processed pulp manufacturing sites, including those in Mexico, has dropped by more than half over the past 15 years to about 22 facilities in 1989.

The largest molded pulp producer, Cascades Inc., continued to grow in 1989. In May, the company acquired all the assets of Diamond Fiber Products Inc. of Palmer, Mass., for an undisclosed amount. The Diamond Fiber Products plant, which now operates under the name Cascades Diamond Inc., makes molded paper products, mainly egg cartons. In the future, the company plans to "substantially increase" the plant's output.

Molded pulp products are made directly from pulp. The furnish is short-fibered, derived usually from clean grades of wastepaper, although groundwood and hardwood sulfate pulp are also used. The secondary fiber or market pulp is first made into a slurry in a conventional pulper, refined, sized, and then formed.

Fibers are drawn from a liquid slurry onto preformed molds by either vacuum suction or cloth covers that catch the fibers. The maximum possible amount of water—usually 25% to 30%—is first removed mechanically, then the molded pulp is either passed through heated tunnels or pressed between heated dies. Molding, pressing, and drying are done in a continuous process.

Molded pulp products are classified into five categories: consumer, food service, retail food packaging, food distribution, and specialty products. These items should not be confused with solid bleached paperboard products, called pressed board, which are machine-stamped or pressed into forms such as dishes. (See Bleached Board chapter.)

The consumer sector is the primary market for molded pulp products. Retail food packaging (particularly egg cartons) and food distribution (especially egg trays and fruit packaging trays) are also major markets.

Consumer products such as disposable tableware (cups, plates, and bowls) are sold in retail stores directly to the consumer. Pressed paperboard reportedly dominates this market, and molded pulp products have the second-largest share, but plastic is "making obvious inroads," according to one industry observer.

Beginning in the early 1970s, plastics and polystyrene eroded a significant portion of molded pulp's share of the

TYPICAL MOLDED PULP PRODUCTS BY END USE

Consumer products
- Tableware
- Plates
- Dishes

Food service
- Plates
- Trays (bottle, food, etc.)
- Carry-out containers

Food distributors
- Egg cases
- Egg trays
- Fruit packs

Food packaging
- Egg cartons
- Meat trays
- Poultry trays
- Cake circles

Specialty
- Florist vases
- Flower pots
- Seed pots
- Interior packaging
- Minnow buckets

STATISTICS OF U.S. PRESSED AND MOLDED PULP INDUSTRY

Year	Number of establishments	Employees (000)	Value of shipments (million $)
1989e	22	3.0	$338
1987	23	3.1	282
1986	—	3.0	271
1985	—	2.9	260
1984	—	3.0	235
1983	—	3.2	227
1982	32	3.2	222
1981	38	3.2	239
1980	—	4.4	225
1979	—	4.6	220
1978	—	5.0	226
1977	38	4.9	240
1976	—	5.3	218
1975	—	5.3	210
1974	—	5.6	205
1973	—	5.6	168
1972	49	6.1	163
1967	58	6.7	146

e = Estimate.
Source: U.S. Dept. of Commerce. Figures for 1988 not available.

food-packaging market, especially egg cartons. Although polystyrene cartons maintain a slightly higher market share, in recent years consumer preference has been gradually shifting back toward molded pulp egg cartons because of their high strength, crush resistance due to thick cushioning, and biodegradability.

International trade in molded pulp products is small because of the high bulk-to-value rate of these products. In 1988, exports were valued at $5.5 million—a 5.8% increase from the 1987 level. Major U.S. export markets for pressed and molded pulp goods in 1988 were Canada (34% of total export value), Hong Kong (16%), the U.K. (11%), and Costa Rica (8.5%). In 1988, U.S. imports of all pressed/molded pulp goods decreased 10% in value from $23.0 million to $20.7 million. Primary suppliers to the U.S. market in 1988 were Canada (62% of total import value), the Philippines (9.5%), and Fed. Rep. Germany (6.5%).

Future outlook. Growth in the molded pulp sector will depend upon its ability to establish its products as biodegradable, economical, and adaptable for a wide range of packaging needs. The pressed and molded pulp goods industry is expected to continue expanding with a 2.3% increase in product shipments during 1990-94, according to analyst Gary Stanley at the Dept. of Commerce. This growth should occur primarily in the food-packaging sector, despite increased competition from plastic, polystyrene, and other non-pulp-based packaging materials. International trade within this sector will remain relatively small, as exports increase by 5.5% and imports by almost 3%.

Competition from plastics and polystyrene products—especially egg cartons—will increase during the next five years. New packaging media using crystallized polyethylene and polystyrene resins will increase competitive pressure on packages made from traditional materials. But molded pulp products are expected to gain market share as consumers become more aware of the nonbiodegradability of plastic products.

Growth in the molded pulp industry will hinge on establishing new end uses for its products, such as trays for use in microwave and conventional ovens. (Currently, over 70% of U.S. households have at least one microwave oven.) The industry can also stress the benefits its products offer in biodegradability and in economical, durable protection for a wide variety of packaging needs.

NORTH AMERICAN PRESSED AND MOLDED PULP PRODUCERS

Company	Location	Capacity (tpd)
American Fibrit Inc.	Battle Creek, Mich.	30
Cascades Inc.	Kingsey Falls, Que.	25
	Rockingham, N.C.	9
Cascades Diamond Inc.	Palmer (Thorndike), Mass.	75
Cascade Dominion Packaging Ltd.	Brantford, Ont.	40
CKF Inc.	Hantsport, N.S.	n.a.
Fibre Form Corp.	Columbia City, Ind.	n.a.
Fripp's Fibre Form Ltd.	Tisdale, Sask.	15
Henry Molded Pulp Products Inc.	Lebanon, Pa.	24
Keiding Inc.	Milwaukee, Wis.	n.a.
Keyes Fibre Co.	Albertville, Ala.	n.a.
	Hammond, Ind.	n.a.
	Sacramento, Calif.	n.a.
	Waterville, Maine	n.a.
	Wenatchee, Wash.	n.a.
Middleton Packaging Inc.	City of Industry, Calif.	15
Montrose Paper Inc.	Chicago, Ill.	82
Packaging Corp. of America	Griffith, Ind.	88
	Macon, Ga.	100
	Plattsburgh, N.Y.	40
	Red Bluff, Calif.	n.a.
Tekmold Inc.	Muskegon, Mich.	8
Woodstream Corp.	Lititz, Pa.	n.a.

n.a. = Not available.

ENVELOPES

The envelope industry manufactures a wide variety of products used by consumers and businesses. The Dept. of Commerce estimates that the industry had sales of about $2.8 billion in 1989, based on output of about 160 billion envelopes. The volume of sales has increased in the last seven years despite increased use of electronic mail and message systems, facsimile machines, and other electronic systems. In 1989, 70% of the industry's envelope shipments were business and commercial stationery envelopes. The leading use for these envelopes is direct-mail advertising. Envelopes used for direct-mail advertising continue to

U.S. ENVELOPE PAPER SHIPMENTS

(000 short tons)[1]

Year	Total	White wove	Kraft
1989	1,139	906	233
1988	1,211	942	269
1987	1,172	916	256
1986	1,121	867	254
1885	1,024	789	235
1984	1,011	774	237
1983	946	715	231
1982	847	639	208
1981	860	638	222
1980	876	650	226
1979	869	635	234
1978	822	592	230
1977	757	554	203
1976	724	520	204
1975	621	457	164

[1] American Paper Institute.

be the strongest growth segment of the envelope industry.

Envelopes are made from three major grades of uncoated paper: white wove, unbleached kraft, and bleached kraft. High-quality business envelopes are made mostly from white wove grades and bleached or semibleached kraft grades, while heavy-duty and padded shipping envelopes are made from unbleached kraft grades. A small amount of envelopes are made with coated papers. The envelope industry used about 1.2 million tons of various paper grades in 1989, a slight decline from the year before.

The Dept. of Commerce estimates that annual real growth in envelope shipments will be about 2.5% during 1990-94. Generally, growth in white wove envelope shipments should exceed that of real GNP growth, while shipments of unbleached kraft will be close to that of GNP levels. Reduced levels of advertising could have a dampening effect on envelope shipments in 1990-91, but growth should resume thereafter.

The future impact of electonic mail systems and electronic fund transfers is difficult to predict because consumer acceptance has been slow. The impact on envelope demand would be serious, however, if large-volume envelope users, such as banks, credit card firms, and retail stores, adopt the new technology.

A more immediate impact has come from the growing use of overnight and express mail services. These firms use heavyweight envelopes made from bleached and unbleached coated paperboard grades, rather than uncoated paper grades. The growth of these services has affected envelope demand in recent years and will continue to penetrate the traditional market for envelopes.

STATISTICAL SUMMARY FOR SIC CODE 2677: ENVELOPES

Year	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987	298	27,900	$2,621	$61.8
1986	—	25,200	2,337	72.8
1985	—	24,000	2,147	74.1
1984	—	25,100	2,169	63.5
1983	—	24,800	1,888	32.6
1982	296	24,400	1,771	45.1
1981	—	25,600	1,601	38.1
1980	—	25,600	1,460	55.2
1979	—	24,900	1,304	38.7
1978	—	22,900	1,121	29.3
1977	265	22,600	991	22.9
1976	—	21,700	870	22.7
1975	—	21,900	830	19.1
1974	—	24,300	868	19.2
1973	—	23,300	690	21.1
1972	247	22,900	621	17.4
1971	—	22,400	573	23.1
1970	—	23,400	574	21.6

Paper consumed (estimated)[1]:
1987: n.a.
1982: 822,800 short tons
1977: 677,000 short tons
1972: 695,000 short tons
Number envelopes produced:
1987: n.a.
1982: n.a.
1977: 97,889 million
1972: 96,599 million

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
n.a. = Not available.
1. An estimated 13,000 tons of paperboard included for 1977 and 29,000 for 1972.
Source: Bureau of the Census.

BAGS (EXCEPT TEXTILE): SHIPMENT AND TONNAGE BY TYPE

	1987	1982	1977
Grocers bags and sacks			
Product shipments (million $)	916.4	917.1	612.6
Product shipments (000 tons)	1,657.9	1,913.1	1,699.0
Variety (merchandise) bags			
Product shipments (million $)	106.7	152.6	139.7
Product shipments (000 tons)	123.1	212.8	255.1
Shopping bags (uncoated)			
Product shipments (million $)	60.8	37.4	33.2
Product shipments (000 tons)	35.0	30.0	42.0
Other paper bags			
Product shipments (million $)	24.7	56.8	12.3
Product shipments (000 tons)	n.a.	56.1	21.9
Specialty bags and liners (coated)			
Product shipments (million $)	400.4	205.5	210.6
Product shipments (000 tons)	n.a.	153.1	n.a.
Shipping sacks (single and multiwall)			
Product shipments (million $)	1,187.3	846.5	658.8
Product shipments (000 tons)	n.a.	n.a.	997.6

Note: Polyethylene grocery and variety bag tonnage was estimated at 133,000 tons valued at $267.8 million in 1982. Plastic shipping sack: 22,000 tons valued at $38.6 million.
n.a. = Not available.
Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2675: DIE-CUT PAPER AND BOARD

Year	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987	393	15,500	$1,739	$29.4
1986	—	17,900	1,795	31.0
1985	—	16,900	1,730	35.0
1984	—	17,500	1,931	46.7
1983	—	16,300	1,898	30.4
1982	398	15,900	1,680	32.7
1981	—	17,200	1,677	23.2
1980	—	16,600	1,454	41.0
1979	—	17,000	1,468	32.7
1978	—	15,100	1,189	26.4
1977	371	14,300	1,058	15.3
1976	—	15,300	1,027	28.6
1975	—	14,800	943	17.1
1974	—	16,500	923	23.3
1973	—	15,900	747	12.9
1972	374	15,200	676	10.6
1971	—	17,300	612	17.8
1970	—	18,200	612	17.8

Paper consumed (estimated):
1987: n.a.
1982: 355,400 short tons
1977: 259,000 short tons
1972: 510,000 short tons
Paperboard consumed (estimated):
1987: 641,100 short tons
1982: 983,600 short tons
1977: 927,000 short tons
1972: 953,000 short tons

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
n.a. = Not available.
Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2676: SANITARY PAPER PRODUCTS

Year	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987	129	38,100	$11,593	$429
1986e	—	37,800	11,153	466
1985	—	38,000	10,751	487
1984	—	38,100	10,327	313.0
1983	—	36,700	9,240	373.0
1982	138	36,700	9,086	271.1
1981	—	36,600	8,346	248.2
1980	—	37,700	7,636	250.9
1979	—	37,700	6,615	265.4
1978	—	35,000	5,591	210.6
1977	120	34,500	4,921	199.1
1976	—	32,900	4,410	108.4
1975	—	31,400	3,884	121.2
1974	—	31,300	3,265	65.2
1973	—	28,200	2,325	109.0
1972	108	26,300	2,072	119.6
1971	—	24,000	1,716	52.9
1970	—	24,600	1,654	50.5

Paper consumed (estimated):
1987: 3,488,600 short tons
1982: 3,598,100 short tons
1977: 3,651,000 short tons

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
e = Estimate.
Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2678: STATIONERY PRODUCTS

Year	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987	189	11,500	$1,229	$25.4
1986	—	12,700	1,201	43.5
1985	—	12,400	1,102	48.9
1984	—	13,600	1,173	42.2
1983	—	13,100	1,132	20.8
1982	214	12,600	1,034	21.4
1981	—	11,900	892	13.1
1980	—	13,000	836	12.7
1979	—	13,400	766	14.6
1978	—	13,900	747	18.4
1977	242	12,600	652	15.9
1976	—	12,300	653	12.7
1975	—	12,100	591	15.5
1974	—	13,300	605	8.0
1973	—	15,000	493	6.5
1972	431	14,700	450	9.3

Paper consumed (estimated):
1987: 536,800 short tons
1982: 447,300 short tons
1977: 470,000 short tons
1972: 511,000 short tons

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2679*: MISCELLANEOUS CONVERTED PRODUCTS

Year	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987	785	30,700	$3,672	$75.6
1986	—	28,400	3,223	73.0
1985	—	29,300	3,136	70.4
1984	—	31,600	3,196	70.1
1983	—	31,700	2,817	36.2
1982	809	30,400	2,638	74.3
1981	—	33,300	2,836	57.9
1980	—	35,200	2,554	76.5
1979	—	34,700	2,263	92.9
1978	—	35,100	2,126	92.8
1977	871	34,300	1,938	62.0
1976	—	28,100	1,507	35.2
1975	—	27,000	1,301	37.0
1974	—	29,600	1,284	49.8
1973	—	27,600	1,001	33.4
1972	356	24,200	793	25.5

Paper consumed (estimated):
1987: n.a.
1982: 574,300 short tons
1977: 424,000 short tons
1972: 495,000 short tons
Paperboard consumed (estimated):
1987: 224,000 short tons
1982: n.a.
1977: 169,000 short tons
1972: 112,000 short tons

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
* = Industry definition changed for 1987.
n.a. = Not available.
Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2657*: FOLDING PAPERBOARD BOXES

Year	Plants	Employees	Value of shipments ($ million)	Capital expenditures ($ million)
1987	601	50,500	$5,687	$180.3
1986e	—	36,200	4,560	—
1985	—	36,000	4,447	—
1984	—	35,600	4,421	131.0
1983	—	42,600	3,967	94.3
1982	564	43,700	3,902	105.0
1981	—	44,300	3,557	101.0
1980	—	45,500	3,277	92.2
1979	—	45,000	2,950	76.8
1978	—	45,600	2,884	100.0
1977	574	44,700	2,579	89.8
1976	—	40,600	2,233	65.2
1975	—	38,300	1,952	67.0
1974	—	43,200	1,890	60.0
1973	—	45,300	1,644	41.8
1972	544	45,300	1,487	37.4
1971	—	44,900	1,366	33.7
1970	—	48,700	1,387	49.9

Paperboard consumed:
1987: 3,977,800 short tons
1982: n.a.

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
* = Industry definition changed for 1987.
n.a. = Not available.
e = Estimate.
Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2655: FIBER CANS, DRUMS, AND SIMILAR PRODUCTS

Year	Plants	Employees	Value of shipments (million $)	Capital expenditures (million $)
1987	280	12,400	$1,517	$70.9
1986	—	12,600	1,517	63.1
1985	—	13,500	1,697	60.5
1984	—	13,900	1,692	41.1
1983	—	14,100	1,627	35.0
1982	307	14,100	1,474	31.1
1981	—	16,200	1,496	37.3
1980	—	15,900	1,370	42.9
1979	—	17,100	1,297	31.2
1978	—	16,300	1,119	23.6
1977	309	16,100	1,011	26.7
1976	—	16,600	936	26.6
1975	—	16,900	837	27.5
1974	—	19,600	828	30.5
1973	—	18,200	673	16.8
1972	282	17,300	568	17.9
1971	—	16,200	495	16.4
1970	—	16,500	465	16.1
1969	—	16,400	445	16.8

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
Source: Bureau of the Census.

STATISTICAL SUMMARY FOR SIC CODE 2652: SETUP PAPERBOARD BOXES

Year	Plants	Employees	Value of shipments (million $)	Capital expenditures (million $)
1987	—	8,600	$433.5	$10.3
1986	—	9,100	552	13.2
1985	—	9,200	479	16.8
1984	—	9,300	466	18.0
1983	—	12,300	569	14.1
1982	261	10,600	433	10.0
1981	—	13,700	511	18.6
1980	—	13,500	465	16.2
1979	—	13,400	434	14.6
1978	—	13,700	409	17.6
1977	312	13,100	361	8.8
1976	—	15,500	402	4.6
1975	—	14,500	350	15.1
1974	—	18,300	387	5.6
1973	—	16,000	320	5.7
1972	395	18,100	321	6.4
1971	—	19,700	332	8.5
1970	—	22,000	326	12.0

Paperboard consumed (estimated):
1987: n.a.
1982: 199,800 short tons
1977: n.a.

Note: Some SIC codes for converted products have been renumbered according to the 1987 Standard Industrial Classification Manual. Although the SIC numbers are different, the categories they describe are the same as the 1982 census, except where otherwise noted.
n.a. = Not available.
Source: Bureau of the Census.

PLASTIC RESINS AND CONVERTED PRODUCTS

Plastic resins and films are used in a variety of paper converting operations, and they represent the principal competition to paper and paperboard packaging. Polyethylene (PE), the largest-volume plastic resin in packaging, is used to make retail bags, garbage bags, milk jugs, soft-drink bottles, food packaging, and a variety of other items. PE and latex resins are also used by the paper industry for coating, binding, and laminating applications. Most paper tissue products are wrapped and bundled in plastic film.

Other major resins used in packaging include polystyrene (PS), polypropylene (PP), and, to a lesser degree, polyvinyl chloride (PVC).

The U.S. plastics industry suffered a setback in 1989 due to a series of petrochemical plant accidents and weaker demand for resins. Total industry production dropped 2.1% to 58.5 billion lb from 59.8 billion lb in 1988. However, total sales, including Canadian imports, increased 1.9% to 59.7 billion lb from 58.5 billion lb the previous year. The sales growth rate was the smallest increase recorded since the downturn of the early 1980s.

Average annual growth for plastics over the past 25 years has averaged above 5% per year. Plastics have replaced other materials in hundreds of applications, including food containers, carpet fibers, furniture, and automobile parts. Paper and paperboard products facing competition from plastics include kraft bags/sacks, milk cartons, folding cartons, paper cups/plates, composite cans, and corrugated containers.

U.S. PRODUCTION OF SELECTED RESINS

(million lb)

Year	LDPE[1]	HDPE[1]	PS	PP	PVC	Total industry[2]
1989	9,695	8,102	5,104	7,238	8,478	58,529
1988	10,397	8,400	5,187	7,274	8,350	59,762
1987	9,599	7,995	4,780	6,647	7,971	55,751
1986	8,903	7,182	4,470	5,812	7,256	50,848
1985	8,889	6,671	4,054	5,139	6,772	47,946
1984	8,413	6,085	3,838	4,940	6,760	46,336
1983	8,041	5,691	3,767	4,434	6,066	42,777
1982	7,503	4,928	3,191	3,477	5,326	36,607
1981	7,693	4,695	3,621	3,955	5,707	39,867
1980	7,291	4,405	3,521	3,648	5,470	37,347
1979	7,793	5,010	4,005	3,841	6,119	41,577

1. Includes LLDPE/HDPE swing capacity.
2. Total includes some resins not listed.
Source: Society of the Plastics Industry.

Packaging consumed more than 18 billion lb of plastic resins in 1989—or 31% of total industry sales. Building and construction consumed 22%; consumer products, 10%; electronics, 6%; furniture, 4%; transportation, 5%; coatings/adhesives/inks, 4%; exports, 9%; and miscellaneous products, 9%.

Prices of commodity plastic resins declined last year about 20% from a peak in fourth-quarter 1988. The price erosion probably would have been greater, but market supply became tight in the second half of the year, following several plant explosions. Producers stabilized prices from further eroding and announced new price increases in early 1990. The price hikes averaged only about 3¢/lb, however, because the startup of new capacity and weakening customer demand eased shortages.

Volatile market cycles are endemic to the plastics industry. In early 1989, producer prices began eroding. Benchmark PE grades that sold for more than 50¢/lb in the spring dropped to between 35¢ and 40¢/lb in the third quarter. The market was disrupted mainly by a sharp drop in exports to People's Rep. China and by a surge in new capacity. People's Rep. China, which had been placing huge orders for PE and was the industry's fastest-growing export market, abruptly halted orders in early 1989. Buyers assumed that excess PE resins would be readily available and that prices had peaked, so they began to draw down inventories rather than order new product. Producer efforts to hold prices firm was undermined by increasing production capacity.

During the first half of the 1970s, the plastics industry initiated a similar series of expansion and debottlenecking projects as resin inventories became increasingly tight. Eventually, the expansions led to significant overcapacity, resulting in a downward trend in profits and lower prices for resins. These market conditions prompted several major petrochemical companies to sell their commodity plastic resin businesses. However, current activity suggests that resin producers are formulating their strategies more prudently, especially with respect to the four major resins: PE, PP, PS, and PVC. Despite periodic disruptions, most producers believe that over the long haul—across both the peaks and troughs of the business cycle—the plastic market will continue to expand.

With few exceptions, most major U.S. resin producers are diversifying their revenue base away from the cyclical commodity resin business and integrating production of downstream consumer products. Leading producers such as Amoco Chemical Co., Dow Chemical Co., Exxon Corp., Mobil Chemical Co., and Union Carbide Corp. have all made investments in recent years to expand downstream fabrication of value-added products and to increase their total market share. For example, Dow Chemical, which produces PE resins and film, moved into consumer goods with the development of Ziploc resealable plastic bags, a product worth $200 million in annual sales. Dow increased the value of its PE film by a factor of four when it was converted downstream into bags.

U.S. PRICE TRENDS FOR SELECTED RESINS

(¢/lb, fourth quarter)

Year	LDPE	HDPE	PS	PP	PVC
1989	36.0¢	43.0¢	47.0¢	39.0¢	36.0¢
1988	51.0	51.0	58.0	49.0	43.0
1987	38.0	39.0	53.0	44.0	37.0
1986	28.5	32.0	35.0	34.0	29.0
1985	30.0	31.0	34.0	36.0	27.0
1984	30.0	32.3	37.0	35.0	24.0
1983	40.0	37.0	—	—	—
1982	27.0	35.5	—	—	—
1981	28.0	39.0	—	—	—
1980	34.0	37.0	—	—	—
1979	38.5	39.3	—	—	—

Sources: *Modern Plastics, Plastics News.*

The short-term outlook for major-volume resins is not good. Several years of booming profits and rapid capacity expansion followed by the current slowdown is leading the industry toward a downturn, according to a number of analysts. The Society of the Plastics industry, in a 1990 forecast that assumes a stronger second half of the year, estimates that total-year growth in domestic sales of U.S.-made resins will be no more than 1%.

Capacity expansions announced by U.S. producers for 1990 or 1991 startup amount to an increase of 22% for PE, 16% for PP, 6% for PS, and 16% for PVC. Assuming the forecast growth rates of 1% in 1990 and 5% in 1991, capacity utilization by the end of 1991 would be only 81% for PE, 69% for PP, 80% for PS, and 77% for PVC.

Although every major plastic resin will show some growth over the next several years, the pace will slow. What worries producers is the continued sluggish demand for domestic resins. In packaging, plastic's market penetration is being spurred along by the development of new plastic materials that provide equal or better performance at a lower cost per unit than other materials. However, these technological achievements are being overshadowed by the issue of solid waste disposal.

Plastic's permanence in the environment (nonbiodegradability) and the low level of plastics recycling are major concerns for the future. Although plastic accounts for only 8% of municipal solid waste, it is the primary target of restrictive legislation because it is the fastest-growing segment of the packaging industry. While disposable PS-foam food containers and plastic bags have received the most negative publicity, several state and municipal governments are considering legislation to ban or tax any nonbiodegradable or nonrecyclable plastic packaging.

PLASTIC RESINS

Packaging comprised the largest category of resin sales in 1989—about 18 billion lb—but growth rates cooled considerably from prior years.

Among the major packaging resins, sales of high-density polyethylene (HDPE), commonly used for plastic bags and sacks and blow-molded containers, increased only 1.1% to about 8.2 billion lb. Sales of low-density polyethylene (LDPE), used for plastic coatings, films, and bags, were flat at about 10.1 billion lb after factoring out Canadian imports. PS sales, spurred by disposable food-service packaging and consumer electronics, rose 2.1% to about 5.1 billion lb. PP sales, used in injection-molded food containers and flexible packaging, increased 3.3% to about 7.3 billion lb., production increased 9.4%, and sales grew 5.5%

Polyethylene. Good market conditions have prevailed in recent years for this major resin group, which accounts for one-third of total plastic industry capacity, but now capacity additions are expected to outstrip demand growth.

Nine of the ten top U.S. resin suppliers have announced

PE capacity expansions totaling 4.4 billion lb for 1989-91. About 2.4 billion lb is scheduled to come onstream in 1990. Current PE capacity is about 20.2 billion lb. Of that amount, 6.6 billion lb is low-pressure HDPE, 7.9 billion lb is high-pressure LDPE, and 5.7 billion lb is low-pressure capacity that can swing between linear low-density polyethylene (LLDPE) and HDPE.

HDPE demand is forecast to increase about 5% in 1990 because of strong demand for milk, juice and bottled water containers, thin-gauge bags and sacks, and more capacity availability. Last year's explosion at a Phillips Co. facility in Texas shut down 20% of U.S. HDPE capacity in the fourth quarter and pushed prices up. Prices of HDPE blow-molding grades had slipped from a peak of 51¢/lb in fourth-quarter 1988 to about 43¢/lb in third-quarter 1989 as market tightness eased, but then prices jumped to about 46¢/lb by early 1990 after the Phillips explosion.

Conventional LDPE demand is forecast to increase about 1% in 1990, and LLDPE demand is expected to increase 5%. In 1989, LDPE sales were 6.9 billion lb and LLDPE sales were 3.9 billion lb. LDPE prices dropped 27.5% to about 37¢/lb in the fourth quarter of 1989 from the previous year.

Demand for thin-gauge LLDPE is strong for grocery sacks and retail bags, flexible food packaging, and shrink/stretch wrapping. Because of plastic's lower price, it has gained about 50% of the U.S. grocery sack market and 75% of the retail bag market. For example, heavyweight kraft paper grocery sacks sell for more than $40/thousand sacks, while plastic sacks sell for about $20/thousand sacks. This price differential has actually increased in the past several years, leading to further market share loss by kraft paper, notwithstanding increasing consumer opposition to plastics. Most supermarkets remain attracted to the cost savings of plastic bags.

LDPE is also widely used as a protective barrier coating on paper and paperboard substrates. In 1989, a total of 730 million lb of LDPE resins were used for coating applications, representing about two-thirds of total consumption of plastics coatings in the U.S.

Polystyrene. PS prices dropped 19% to 47¢/lb in 1989 from the previous year, caused mostly by more stable markets for resins and lower prices for styrene monomer feedstock. Prices had risen to 60¢/lb in mid-1988, when styrene feedstock prices reached a record-high level of 42¢/lb and pushed PS prices to new levels. Producers are adding capacity to the 1989 total of 6.3 billion lb but are also shutting down older plants to avoid overcapacity. Demand is forecast to increase about 2% to 3% in 1990, similar to 1989.

One product that has boosted PS growth in food packaging is the fast-food clamshell container popularized by McDonald's Corp. Gains have been achieved in other fast-food disposables, resulting in the displacement of bleached paperboard cups, plates, and food containers. Egg cartons produced from PS resins also have displaced molded pulp egg cartons. The use of PS disposables has not fallen off significantly in the past two years, despite increasing opposition from local governments and consumer groups. In mid-1989, the eight major U.S. producers of PS jointly funded a $16 million program to create a Polystyrene Packaging Council. The group's goal is a 25% recycling rate for polystyrene products by 1995 (roughly equivalent to total paper recovery rate in 1989).

Polypropylene. In 1989, PP prices dropped about 20% from the previous year to 39¢/lb. About 1 billion lb of new PP capacity was added in the U.S. in 1989; in 1990, another 1.5 billion lb could be added, although a few announced expansions may be delayed or cancelled. Capacity is currently about 9.6 billion lb. Sales increased 3% in 1989 and should remain near that level in 1990. Still, overcapacity is a real concern.

PP resins are used to produce injection-molded food containers and bottle closures and flexible packaging films. PP resins are also used to manufacture a wide variety of medical, pharmaceutical, and electrical products. PP resins are often substituted for higher-priced resins during periods of high prices, such as in 1988.

PLASTIC PACKAGING

Food packaging is the largest segment of the plastics packaging industry, and plastic bottles and flexible films are the leading products in this segment. Plastic bottles and films are popular with food manufacturers because their

ESTIMATED CAPACITY OF TOP 20 U.S. COMPANIES PRODUCING PLASTIC RESINS

	Company	1989 annual capacity (million lb)	Major grades
1,	Quantum[1]	4,420	LDPE, LLDPE, HDPE, PP
2,	Dow	3,815	LDPE, LLDPE, HDPE, PS
3,	Occidental[2]	3,250	LDPE, HDPE, PVC
4,	Union Carbide	2,940	LDPE, LLDPE, HDPE, PVC
5,	Himont	2,750	PP
6,	Exxon	2,420	LDPE, LLDPE, HDPE, PS
7,	Novacor[3]	2,100	LDPE, LLDPE, HDPE, PP
8,	Chevron	1,955	LDPE, HDPE, PS
9,	Phillips	1,915	HDPE, PP
10.	B.F. Goodrich	1,750	PVC
11.	Soltex	1,700	LDPE, HDPE, PP
12.	Huntsman[4]	1,540	PP, PS
13.	Amoco	1,520	PP, PS
14.	Shintech	1,500	PVC
15.	Fina	1,460	PP, PS
16	Mobil	1,450	LDPE, LLDPE, HDPE, PS
17.	Eastman	1,400	LDPE, PP, PET
18.	Allied-Signal	1,200	HDPE
19.	Formosa	1,000	PVC
20.	Georgia Gulf	850	PVC

1. Formerly USI Chemicals Div. of National Distiller & Chemical Corp.
2. Occidental Chemical purchased Cain Chemical's PE and ethylene plants in 1988.
3. Novacor Chemicals, a subsidiary of Nova Corp., a Canadian company, purchased Poysar in 1988.
4. Huntsman purchased Shell's 325-million-lb PP plant in 1988.

Source: *Modern Plastics.*

barrier properties ensure freshness while preventing odors, moisture, or vapors from contaminating the product. In addition, plastic materials are lightweight, unbreakable, and often cheaper than other materials. Constar International Inc., headquartered in Chattanooga, Tenn., is the largest U.S. plastic container manufacturer. The company's subsidiary, Sewell Plastics Inc., acquired Owens-Illinois' plastic bottle division in 1987. Other major plastic bottle producers are Johnson Controls, Continental Can, and Amoco. Leading film producers include Quantum, Dow, Union Carbide, Chevron, Phillips, Exxon, and Mobil.

Plastic bottles have made significant inroads into traditional glass and paperboard markets, and plastic films have successfully taken market share from cellophane, paper, and paperboard. Plastic bottle demand is projected to grow more than 5%/year and use 7.6 billion lb of resins by 1992, according to a forecast by Freedonia Group Inc. U.S. demand for plastic film is projected to increase 3.3%/year and consume nearly 10 billion lb of resins by 1992.

Among nonfood applications, one of the most competitive markets is grocery sacks, where kraft paper has traditionally been used. High-strength PE films have captured about 50% to 60% of the market, or 23 billion bags in 1989, up from 5% in 1983. By weight, 23 billion plastic grocery sacks equal about 383 million lb of PE. The leading plastic grocery bag producer is Sonoco Products Co., which also produces paperboard cores, cans, tubes, and plastic shipping drums. Sonoco produces about 8 billion plastic bags annually and has a 35% share of the 23-billion-bag market. Its chief rival is Mobil Chemical, a subsidiary of Mobil Oil Corp., which produces about 6 billion bags annually, representing 25% of the plastic grocery sack market. Sales of plastic grocery sacks are expected to increase about 5%/year, according to industry analysts.

PLASTICS USE IN PACKAGING IN 1989

(million lb)

	LDPE	HDPE	PS	PP	PVC	PET	Total industry
Containers	311	3,400	1,306	454	352	1,049	7,018
Closures	32	81	190	420	36	—	779
Coatings	730	51	—	30	21	10	1,093
Film	3,421	541	211	612	310	—	5,202
Total	4,494	4,073	1,707	1,516	719	1,059	14,092[1]

[1] Total includes some resins not listed.
Source: *Modern Plastics.*

ELECTRONIC COMPETITION

Some analysts still envision a "paperless office," but currently, the technologies expected to reduce reliance on hard copy are actually spurring paper demand. Office electronics and electronic communications include computer printers, photocopiers, and facsimile machines.

"The paperless office will not be here anytime soon," explained Susan Beshalske, industry analyst with Dataquest Inc., a market research firm. "With the information growth and continued overall computer hardware growth, more originals will be generated and copied," she told delegates to a Dataquest conference. "People are comfortable with the familiar . . . and paper is familiar."

ELECTRONICS-RELATED SPECIALTY PAPERS: NORTH AMERICAN MARKET SIZE AND STRUCTURE

(000 tons)

	1988	1989	1990	1991	1992	1993	Compound annual growth 1988-93 (%)
Cut-size							
IC/P*	532,230	682,400	864,770	1,052,700	1,269,140	1,451,290	23%
Ink jet	14,600	26,170	41,160	54,550	54,530	45,250	25
Thermal transfer	2,640	2,800	2,670	2,500	2,580	2,690	1
Total	3,159,750	3,412,740	3,690,610	3,953,030	4,193,300	4,386,700	8
Continuous forms							
Stock	1,620,660	1,736,720	1,805,600	1,854,570	1,872,210	1,875,590	3
Single-part	1,163,470	1,293,540	1,377,860	1,447,280	1,483,990	1,512,220	6
Multi-part	45,720	443,180	427,750	407,290	388,230	363,370	-3
Custom	1,610,320	1,627,650	1,637,660	1,636,460	1,608,440	1,566,710	-1
Single-part	744,550	781,410	807,540	823,160	827,150	826,240	2
Multi-part	865,770	846,240	830,120	813,310	781,290	740,470	-3
Total	3,230,980	3,364,370	3,443,260	3,491,030	3,480,650	3,442,300	1
Facsimile papers							
Thermal	25,320	36,230	49,860	64,020	78,640	93,810	32
Plain paper	270	600	1,620	4,220	10,030	19,320	135
Thermal transfer	1,420	2,430	3,360	4,580	5,640	6,760	37
Total	25,210	39,260	54,840	72,820	94,310	119,890	37
Total all	6,437,430	6,839,570	7,213,100	7,540,590	7,788,300	7,962,050	5

Note: Figures include both cut-size and continuous forms.
*Intelligent copiers/printers, including laser.
Source: BIS CAP International Inc.

Nor has electronic data interchange (EDI) replaced paper in daily business communications, although patterns of paper use have changed.

Teletext, videotext, electronic mail, and CD-ROM (compact disk/read-only memory) help eliminate certain paper transactions but encourage others, especially photocopying. Such online computer services as Prodigy, a joint venture between IBM and Sears; the Dow Jones News Retrieval; Delphi; and Compuserve have gained some popularity for their information and shopping services. But the purchase transactions are almost always followed up by some sort of paper confirmation, and the information retrieved from online services can be stored and printed from the subscriber's computer. Televised home shopping services did cut into some retail or catalog shopping at first, but their popularity is not secure, and a shakeout of sorts has occurred in the home shopping industry.

These electronic transactions generate paper at some point in their processes, including shipping labels and invoices, credit card receipts, product and mailing packaging, and product literature, not to mention the paperwork generated for returns and shipping delays. The real issue, therefore, is the shift in grade mix.

Desktop publishing and personal computers have pushed up demand for quality cut-size papers, replacing, for example, coated specialty paper used in photo typesetting machines. This holds true particularly for newsletters because they can be produced more easily on cut-size paper than newspaper advertising inserts. Subscriber copies of some newsletters are even produced on copying machines, bypassing the commercial printer (as well as uncoated offset paper, a lower-cost sister grade to copy paper) altogether. Desktop publishing is also being used to provide camera-ready copy for some magazines, catalogs, and brochures, which eventually are printed on uncoated or coated papers on web or sheet-fed printing presses. This trend will continue as computer page (laser) printers produce increasingly better-quality type and graphics.

Uncoated free-sheet represented 93% of all U.S. shipments to business forms converters in 1988, while uncoated groundwood, at 170,000 tons, made up most of the balance, with coated paper contributing only 0.8%. Groundwood paper stayed even with 1988, after dropping 25% from 1987.

Placements of personal computer printers in the U.S. jumped from 7.4 million in 1988 to 8.3 million in 1989, according to the Computer and Business Equipment Manufacturers Assn. (CBEMA), an industry trade group. CBEMA projects that shipments will rise to more than 9.5 million in 1990 and to almost 23.9 million by the year 2000.

Cut-size paper (usually 8½ x 11 in.) will continue gaining market share at the expense of continuous computer paper. In fact, Datek Imaging Services, a unit of BIS CAP International, said in its 1990 annual statistical report that cut-size paper will grow at an 18% cumulative rate, and by 1993, it will account for 33% of pages consumed by computer printers. Laser (nonimpact) printers will consume 38% of the 3.5 million total tons of cut-size, a 272% increase from 1988. Multipart custom continuous forms will decline by 3% and stock continuous by 1% cumulatively during the same period, according to Datek.

Cut-sheet paper for copiers will rise from 1.7 million tons in 1988 to 2.2 million tons in 1993—a 5% compound annual growth rate. The Canadian cut-sheet copier market is growing at 6% CAGR (compound annual growth rate) and will total 161,000 tons in 1993, Datek said.

Major suppliers of laser printer papers include Boise-Cascade Corp., the Hammermill unit of International Paper Co. along with IP's Springhill lines, James River Corp., Mead Corp.'s Gilbert Paper Co., and Georgia-Pacific Corp. (including Great Northern Nekoosa Corp.). Perhaps the greatest opportunities for these mills are in electronic publishing, which so far has only about 5% penetration in the business community.

Office equipment manufacturers (OEMs) predict that within five years, laser printers will match the quality of professional typesetting equipment, pushing laser printers ahead even more. Demand for office specialty papers is expected to double in the U.S. between 1987 and 1992, one study noted. Demand for these grades, which include computer printer and thermal papers, will rise from 134,000 tons in 1987 to 249,000 tons by 1992. Sales will jump from $931 million in 1987 to over $1.8 billion by 1992.

Bond and writing papers have experienced tremendous growth in demand during the last two decades. Annual shipments rose from 372,000 tons in 1960 to 2.8 million tons in 1988. The U.S. market rose over 7% in 1988 from the year before.

Copies, copies, and more copies. No. 4 bond—copy paper—also known as cut-size bond, is continuing its rapid growth due to the increased sophistication and use of copiers and the growth in computer-page printers (laser printers). Cut-size consumption will increase at a cumulative annual growth rate of 5%—from 1.7 million tons in 1988 to 2.2 million tons in 1991, according to the Datek report. Personal copying and that done by retail copy shops both will post 11% growth rates.

Put another way by Dataquest, copiers consumed an estimated 493 billion sheets in 1989, and that will increase to almost 600 billion in 1994. However, the 4.0% CAGR for the 1989-94 period is slower than the 9.9% CAGR experienced from 1984-89, Dataquest said. Similarly, page (laser) printers accounted for about 615 billion sheets in 1989 and will rise to 1.139 billion sheets in 1994—a 13.1% CAGR, slightly higher than the 12.9% rate experienced from 1984-89. The growth in copier paper use is virtually the same as that for copy machines themselves: 4.2% CAGR.

OEMs are introducing new copiers with technological advancements (e.g., color xerography) requiring unique, high-quality papers. But not all OEMs are out hunting for paper to meet their technologies. Mead invented both a process and a paper/film substrate to go with it, then tried to interest OEMs in its new Cycolor process. Mead has been quasi-successful, though earnings on Cycolor are behind original projections.

According to George Treier, principal engineer for Xerox Corp., the new copy printing technologies will increase emphasis in certain areas, including the following: systems and postimaging applications that require customized applications using a range of basestocks and preprinted and perforated papers; higher-speed and higher-resolution xerography, using laser imaging and electronics; color xerography; ionography; and inkjet technology in the low and low-medium usage segments—black and white as well as color.

Fax it to me. Fax machines are everywhere—offices, retail businesses, copy shops, homes, and even automobiles. Faxes even played a role in disseminating information about the democracy protests in People's Rep. China's Tienanmen Square in 1989.

CBEMA estimates that domestic shipments of facsimile equipment are growing at a 29.6% CAGR for the 1979-2000 period. Shipments in 1989 were over 1.7 million units and were expected to rise a whopping 35.0% in just one year (1990) to more than 2.3 million units. Demand is increasing partly because of falling prices for the units, as happened with low-end copiers, calculators, and computers.

The North American fax paper market is small compared with commodity-oriented areas (cut-size, offset, etc.), but thermal paper use will grow by 32% compounded annually from 25,000 tons in 1988 to 94,000 tons in 1993 (excluding plain paper and thermal transfer paper), according to BIS CAP.

Thermal paper is a value-added product, usually selling for about two-and-a-half times the cost of similar-quality paper. Appleton Papers Inc., currently North America's major producer of thermal paper with an approximate 1990 capacity of 25,000 tpy, accounts for about 32% of total U.S. capacity, according to some industry estimates. Just below that is Kanzaki Specialty Papers, 20,000 tpy; Ricoh Corp., 15,000 tpy; Nashua Corp., 5,000 tpy; Azon Corp., 3,600 tpy; 3M/Lanier and NCR Corp., each 3,000 tpy; and Labelon Corp., 2,500 tpy.

Ricoh, which claims to be the pioneer in development of the modern fax machine, is expanding its capacity in the U.S. by adding a new converting plant in Georgia and licensing its technology to Azon, Johnson City, N.Y. Azon will produce about 3,600 tpy of fax paper. In addition, the company's Ricoh Electronics Inc. subsidiary, which has manufactured thermal labels for point-of-sale systems since 1985, began making fax paper in August 1989. (Ricoh also licenses its technology to Renker GmbH & Co. KG, Fed. Rep. Germany.) Endoh predicts that Ricoh "will be able to supply about 20% of the North American market for high-sensitivity thermal paper by 1990, compared with Appleton's approximately 50% market share." Kanzaki has additional capacity in Japan, as does Oji Paper (about 9,000 metric tpy) and others.

Other small niches. Label paper (some of which is thermal), is used for such applications as bar codes on wrapped-to-order supermarket foods (similar to the preprinted universal product codes [UPC] on packaged goods). Labels are also used by basic manufacturers, especially automakers, for inventory control.

Chart paper (e.g., electrocardiogram readouts) will increase 34%, and tag ticket (e.g., airlines' bristol-based automated ticket/boarding pass, which uses thermal transfer bar coding) will grow 40%. On the losing end of market share is computer and other printer papers, which could decline 41% by 1991, CAP said.

Videologs. Though unlikely to replace paper on a mass scale anytime soon, another area of potential competition is catalogs. Sears is part of the Prodigy information system, whose users can order merchandise from Sears (and other vendors) via computer. Another major catalog retailer, Spiegel Inc., has had some success selling its video catalogs. Customers cannot yet actually place orders from video catalogs. Instead, the videos are shipped with the paper catalog as a selling enhancement tool. Videos can be purchased or rented.

More and more reference books are being introduced in electronic versions. The *Oxford English Dictionary*, Britannica's *Compton's Multi-Media Encyclopedia*, and Grolier's *Academic American Encyclopedia* are available on CDs that can be read by a personal computer with a CD-ROM drive.

MAJOR PAPER GRADES AFFECTED BY ELECTRONIC COMPETITION: U.S. SHIPMENTS

(000 short tons)

	1989	1988r	1987	1986	1983	1980	1975
Newsprint	6,088	5,982	5,842	5,630	5,167	4,672	3,691
Groundwood specialties							
Directory	662	643	605	600	450	450	300
Catalog	498	488	540	540	425	375	300
Groundwood forms	170	171	230	325	240	230	75
Groundwood book	90	82	65	70	125	130	130
Uncoated free-sheet							
Forms bond	2,097	2,110	2,133	2,100	1,700	1,500	950
Envelope stock[1]	905	929	907	850	700	660	460
Offset book	2,525	2,739	2,736	2,634	2,210	2,000	1,450
Bond and writing	2,812	2,803	2,619	2,375	1,840	1,800	1,000
Tablet	365	378	425	400	400	325	230
Coated paper							
Nos. 1 to 4, two-side	3,244	3,179	3,150	2,760	2,300	1,800	1,200
No. 5, two-side	3,535	3,478	3,300	3,120	2,960	2,400	1,650

r = Revised.

[1] Does not include brown, bleached, or semibleached kraft envelopes.

Sources: *Pulp & Paper Forecaster*, Newsprint Information Committee, Canadian Pulp & Paper Assn., American Paper Institute.

POTENTIAL IMPACTS OF ELECTRONIC AND COMPUTER TECHNOLOGY ON PAPER CONSUMPTION

	Use	Equipment	Grades and end uses affected
MESSAGES			
Electronic mail	Office	Microcomputer and modem	Some loss in first-class mail and copy paper
Voice mail	Office	Same as above	Same as above
Facsimile	Office	Fax equipment	Specialty papers; some loss in first-class and express mail
Colored copying	Office	Special copiers	Specialty papers
Work office	Office/home	Word processors, microcomputer	Copy, bond, forms
INFORMATION			
Database + optical or magnetic storage disks	Directories, catalogs	Microcomputer coupled with up-to-date database	Forms, groundwood papers, business-to-business directories and catalogs
Wide-area networks	Telephone directories, interchange of data	Microcomputer or telephone-supplied equipment coupled with mainframe computers	Telephone directories
Videotext	A. General information B. News/editiorial C. Classified advertising D. Electronic shopping	Microcomputer coupled with mainframe computers with large databases	A. Forms, publications B. Newspapers, magazines, references C. Newspapers D. Catalogs/coated, groundwood papers
Optical/magnetic disk storage	Office files and records	Scanners and optical/disk storage, plus microcomputers	Label, security papers, copy, file folder, index
Electronic data interchange (EDI)	Invoicing, purchasing inventory, financial reporting	Computers	Forms, business papers
OCR/MICR	Banking, inventories, sales	Scanners, computers	Label, security papers, forms
PUBLISHING			
Desktop	Offices, publishers	Microcomputers, laser printers	Copy, coated
Videotext	Home	Microcomputer coupled with large databases	Books, magazines
Laser printers	Office	Nonimpact printer	Bond/copy, forms
High-resolution TV	Home	TV receiver	Less print

Though less expensive than the printed version, the Grolier CD does not yet have photographs and illustrations. Grolier, possibly the third-largest encyclopedia publisher behind Britannica and World Book, is also working on a CD-interactive system that will have sound, motion, and illustrations. The company expects widespread acceptance to take ten years or more, without having a major effect on total paper use.

Standard computer word-processing programs now come with spelling checkers/dictionaries, replacing some of the need for printed versions, and more complete versions of dictionaries can be purchased separately. *Publishers' Weekly* said that the electronic dictionary may get a boost from inclusion of the Webster's Dictionary database in the NeXT computer. The second edition of the *Random House Dictionary* is also being put onto a database. Of course, computers are used to produce major reference works because databases can be updated faster and more accurately.

Microsoft Corp., publisher of the word processing program "Word," has developed a package called "Bookshelf." It contains ten programs, including *World Almanac and Book of Facts*, *Bartlett's Familiar Quotations*, *American Heritage Dictionary*, a zip code and post office directory, *Business Information Sources*, *Chicago Manual of Style*, Roget's II Electronic Thesaurus, and two others.

Telephone directories are also showing up in electronic form. A company called SilverPlatter Directories Inc. sells CDs containing about 100 million U.S. residential and business telephone and address listings, according to *Business Week* magazine. Unlike telephone books, which usually are free or inexpensive, the SilverPlatter disk set costs almost $3,000. It is easier to use, however, for activities such as compiling mailing databases that need to be easily broken out by various demographic criteria.

Bells are ringing. So far, newspaper publishers have successfully kept the Regional Bell operating companies (RBOCs)— formed with the breakup of AT&T—from entering completely into the information industry, fearing that if RBOCs are allowed to generate the information they carry (provide online services), they could hurt dissemination of news by publications. Congress is currently trying to get the two industries to work out a compromise. RBOCs are anxious to expand their own data services because printed telephone directories face competition from electronic information services.

Business- or consumer-oriented electronic information exchanges using personal computers have been started in Canada by Tele-Direct (Publications) Inc., the publishing arm of Bell Canada Enterprises Inc. The French national telephone company has had success with MiniTel, an inexpensive electronic directory system that is combined with videotext service. The company plans to replace all telephone books with electronic terminals by 1995. Terminals are distributed free of charge through the post office, but only on short-term loan. The U.K. has had little success with Viewtel, an electronic newspaper service.

In the U.S., phone-in yellow pages services offer free, updated advertising information to callers. Consumers can call for a telephone number or be connected directly with a person or business. One talking-yellow-pages entrepreneur brazenly predicted "it will affect [printed directories] to the point of extinction."

Business forms industry changing. The business forms industry also is most affected by advancements in electronic information generation. It is estimated that the business forms industry may decline 10% over the next several years, as complex (and profitable) forms for bills of lading, purchase orders, etc. are replaced by EDI and by forms generated via personal computers. Many forms programs provide templates that users can merely fill in and print or send electronically (though often both). Perhaps 30% of overnight package service traffic consists of documents that are vulnerable to replacement. Also, some overnight courier services are replacing multipart shipping forms with single-part forms on label stock with release backing for at least some customers. Dataquest expects the market for forms processing software to be $359 million by 1992.

William B. Hull, manager-advanced technology development for The Standard Register Co., wrote in the July 1989 issue of its *Forms Mfg.* magazine that companies using EDI report substantial cost savings. Verne Royster, director of Reseller Sales Div. of FormMaker Software Inc., said in the same issue that for every dollar corporations spend on forms

PRODUCERS OF FACSIMILE PAPERS

Company	Location	1990 estimated tonnage Capacity	Production	Market share*
Appleton Papers[1]	Appleton, Wis.	25,000	20,000	32%
Kanzaki Papers	Ware, Mass.	20,000	10,000	26
Ricoh	Santa Ana, Calif.	15,000	12,000	19
Nashua Corp.	Nashua, N.H.	5,000	4,500	6
Azon Corp.[2]	Johnson City, N.Y.	3,600	Minimal	5
3M/Lanier	St. Paul, Minn.[3]	3,000	1,500	4
NCR Corp.	Miamisburg, Ohio[4]	3,000	2,500	4
Labelon Corp.	Canandaigua, N.Y.	2,500	2,500	3
Total		77,100	53,000	100%

*Based on capacity.
1. Appleton also produces the basepaper.
2. Licensed by Ricoh.
3. Headquarters location.
4. Systemedia Group, headquarters location.
Source: *Pulp & Paper* estimates.

procurement, they spend an additional $20 on storage of the finished product.

EDI—FRIEND OR FOE?

It is estimated that the vast majority of Fortune 500 firms use corporate videotext systems. Estimates of videotext growth predict a $2- to $3-billion industry by 1996.

EDI's major corporate players consist of General Electric Information Services Co., McDonnell Douglas Corp., IBM, AT&T, and Control Data Corp. Also included are database and bulletin board services, such as CompuServe and The Source; several newspaper publishing companies, such as the Dow Jones News Retrieval; and the electronic mail services of MCI and Western Union (that latter two, of course, actually deliver a paper version).

Bank customers are taking advantage of electronic funds transfers (EFTs) between institutions or between customer and institution. Most EFTs are still confirmed on paper in monthly statements. Automated teller machines (ATMs) reduce some internal institutional paperwork, but ATMs issue paper receipts for their transactions. With all this, however, it will be at least five to ten years before EFTs become a significant factor in reducing paper demand.

To read or not to read. The advent of television, even more than movies, has had the most noticeable affect on print media, particularly newspapers, with most publishers and editors lamenting the fact that most people today get their information from TV rather than from newspapers.

Newspaper managers are concerned about inroads by electronic services, as mentioned previously. Still, a newspaper industry analyst expects electronic media to have little appreciable effect on newspapers and newsprint consumption through 1995. EDI could tap into classified advertising, which *Editor & Publisher* magazine calls a lucrative and essentially exclusive service of newspapers.

Consumption of 30-lb basis weight newsprint in the U.S. increased from nearly 10.9 million short tons in 1978 to approximately 14.1 million tons in 1989. Growth rates should slow slightly during the period from 1988 to 1997, at which time consumption will reach about 17.3 million tons.

Until most of the U.S. population owns or uses computers on a daily basis, the potential for EDI growth is restricted. Electronic communications technology (hardware and software), although declining in price, is still fairly costly. Consumers may spend hundreds or thousands of dollars for video and sound equipment, but fewer will lay out that money for computers.

Also, use of electronic data communications requires considerably more effort from the user. It is estimated that getting just 10% of the information contained in a typical daily newspaper from a computer online service would require more time than is required to read the newspaper. Because radio and television are passive systems, they are even simpler to use than newspapers and likely to be the media of choice, long before someone reaches for his or her computer keyboard.

Electronic data and images have affected the magazine industry, primarily in the "news" end of the business. While newsweeklies and other general-interest magazines have lost readership, special-interest magazines continue their strong growth. Many special-interest periodicals use high-value paper, especially coated free-sheet. Others, which care less about looks, use lower-end papers, such as newsprint and groundwood specialties.

EDI—Friend. Paper companies are taking advantage of electronic data exchanges in the forms of EDI, electronic mail (E-mail), online transaction processing, fax, and bar coding for inventory control and distribution. Papermakers taking advantage of electronic data exchange often come from the printing papers side of the business, such as International Paper and its Hammermill Paper Div., Westvaco Corp., Appleton Papers, Champion International Corp., and Georgia-Pacific Corp.'s Nekoosa Papers Div., and from containerboard companies, which began using electronic data exchanges recently.

PULPING AND PAPERMAKING CHEMICALS

As was the case the previous year, 1990 proved to be a "mixed bag" for chemical producers, with some markets showing explosive growth, while sales in others slipped substantially. One of the industry's major stories was again the imbalance in the chloralkali sector due to continuing pressure by legislative bodies and environmental groups to reduce dioxin levels (and other chlorinated organics) in chlorine-based bleach plant effluent.

The softening U.S. economy and slower growth in the paper industry also affected markets, and chemical producers appeared to be gearing down for what some analysts felt could be a recessionary period ahead. Many firms invested in new technologies to reduce production costs and improve efficiency, while others were restructuring and consolidating operations.

Not all the news was grim, however, particularly for hydrogen peroxide and calcium carbonate producers. Those markets were experiencing double-digit growth, and that trend was expected to continue for at least the short- to mid-term. Calcium carbonate sales soared as conversions to alkaline papermaking continued, although the trend seemed to have slowed somewhat in 1990. Considered by many to have long been the premier bleaching additive, hydrogen peroxide was being increasingly used in both mechanical and recycled pulp bleaching applications, and producers were gearing up in anticipation of their biggest year ever in 1991.

PULPING CHEMICALS

Chloralkali. The chloralkali market continued to brace for a major reduction in chlorine consumption by paper producers while searching for new excess chlorine outlets. Chlorine is used as a kraft pulp bleach and influent water purifier, and caustic soda is used in both kraft pulping and bleaching. Chlorine and caustic are coproducts in most well-established production processes, and for years, manufacturers have relied on the balanced consumption of these two chemicals by the paper industry, one of their largest consumers.

While the market was still balanced in 1990 for chlorine and slightly tight for caustic, that situation was projected to change significantly during the next two to three years. In some regions, chlorine imbalance was already being felt, and producers were struggling to maintain 90% operating rates. Estimates put the U.S. paper industry's chlorine consumption for 1990 at 1.76 million tons, equal to 1989 levels and slightly more than 1% below 1988 figures. Caustic consumption, meanwhile, reached 2.4 million tons, a 2% increase over 1989 figures.

Several major companies invested in alternate technologies for producing caustic soda, including Tenneco Minerals, FMC, Texas Gulf, and Atochem North America (the latter two in a joint venture). FMC began operating a lime soda plant—and others have announced plans to do so—that coproduces caustic and calcium carbonate.

The kraft pulp bleaching sector continued to invest heavily in process technology that reportedly reduces dioxin precursors and dioxin formation or that treats dioxin-containing effluent. These technologies include oxygen delignification, extended delignification, chlorine substitution (principally with chlorine dioxide), oxygen/hydrogen peroxide/ozone bleaching, and tertiary and quaternary effluent treatment.

Soda ash. The U.S. soda ash market remained tight as producers continued to be lured by high export prices and anxiously awaited a decision by the European Community on trade tariffs, which were blocking exports to Europe. Domestically, soda ash consumption was expected to be flat at 0% to 2% growth vs 1989 figures. Domestic production for soda ash was expected to top 10 million tons in 1990, a 1% increase. Soda ash was going for $98/short ton (f.o.b. Green River, Wyo.) and $123/short ton for export (f.o.b. California), although export prices varied widely.

Soda ash can be used to make caustic soda or as a substitute for caustic in kraft pulping. In the U.S. paper industry, consumption rose to 150,000 tons, a 20,000-ton increase over the previous year and about 50,000 tons above the base market serving neutral sulfite semichemical (NSSC) customers. The increase was again mostly due to mill conversions from caustic to soda ash. Conversions were progressing at a slower rate than in 1988 and early 1989, when most low-capital conversions took place during tight market conditions. However, more recent conversions were taking place out of necessity, either because of availability or price. For some producers, caustic prices, although rising, were still not grossly out of line with soda ash. Future conversions are most likely to be concentrated in the Northwest, where caustic supply is tight, and less likely in the Southeast, where supply is in better balance.

As in 1989, capacity expansions continued. Sparked by growing offshore demand, Tenneco Minerals (a division of Tenneco Inc.) in a joint venture with Asahi of Japan announced a 600,000-tpy expansion at its Green River facility. The project is slated for completion in late 1992 and will increase output from 1.25 million tpy to 1.85 million tpy, although some observers believe Tenneco is planning a much larger expansion because its permit applications cited a 2.0-million-ton capacity, with an option for 2.7 million tons by 1992. About 20% of the company's output will service Asahi's glass manufacturing facilities in Japan.

BLEACHING CHEMICALS

Hydrogen peroxide. Hydrogen peroxide markets in the North American paper industry experienced healthy gains in 1990, rising to about 225 million lb, or about 25% over 1989 consumption levels. And the overall peroxide market topped 600 million lb for the first time. Paper industry consumption was about equally split between the U.S. and Canada.

The industry saw a flurry of capacity expansion activity by every major producer, as hydrogen peroxide found increasing uses in kraft pulp and mechanical pulp bleaching, as well as recycled fiber bleaching. In all, 134 million lb of new capacity were brought online in 1990, with another 247 million lb scheduled for startup in 1991 and 80 million lb in 1992.

Markets toward the close of the year were well balanced, and prices were firm at a list of $0.343/lb (50% basis), although large users were getting discounts off list.

Producers expected another robust year in 1991, with a 15% to 20% gain forecast in Canadian markets and a 10% to 15% increase in the U.S. However, with the tremendous volume scheduled to hit the market, some producers fear an oversupply, though others feel capacity and demand will be in step because of new market niches being developed.

In the U.S., about 50% of consumption was used in chemical pulp markets, 30% to 40% for mechanical pulp, and 10% to 20% in recycling applications. In Canada, the mix was approximately 70% to 80% mechanical pulps (including bleached chemi-thermomechanical pulp [BCTMP]), 20% to 30% chemical pulp, and a very small (but growing) recycling segment. Effluent treatment was also a growing market but represented only a small portion (10 to 20 million lb) of the total paper industry business.

A growing number of mills were also reported to be using "a small amount" in high-density storage chests to reduce heat-related brightness reversion that may be incurred in the dryer section of the paper machine. This practice is particularly applicable to finished products requiring high (90+) final brightness levels. The application was new in that it was being adopted as a "brightness safety factor," primarily at mills using high levels of chlorine dioxide substitution, which in itself was a relatively new and growing practice in response to environmental pressure to reduce dioxin and chlorinated organics. Some mills reported, however, that high-density addition could be eliminated for certain grades if both oxygen and hydrogen peroxide were used in the first extraction stage (Eop or Epo).

Oxygen. Oxygen consumption continued to rise rapidly in the paper industry as more mills added oxygen to bleaching extraction stages and employed oxygen delignification systems. Eight new onsite facilities are being installed in the U.S., bringing to 12 the number of paper mills using

CHEMICAL CONSUMPTION BY U.S. PULP AND PAPER ESTABLISHMENTS IN 1982 AND 1987

(000 short tons)

Chemical	1987	1982
Sulfur	299.4	271.3
Chlorine	1,606.0	1,334.9
Sodium hydroxide (caustic soda) (80% sol.)	2,825.9	2,153.4
Sodium sulfate, including saltcake (100% Na_2SO_4)	509.8*	905.4
Sodium chlorate (100% $NaClO_3$)	442.4	309.5
Aluminum sulfate (17% Al_2O_3)	526.0	481.0
Titanium dioxide**	414.1	310.7
Rosin sizing**	263.3	267.1
Lime	1,506.3	1,172.0
Kaolin and ball clay	2,672.7	2,271.9
Starch**	2,039.8	1,720.6
S/B latex**	272.6	n.a.

*Bureau of Census estimate.
**Million lb.
n.a. = Not available.
Source: Bureau of the Census, Census of Manufactures.

captive supplies of oxygen. In Canada, two onsite plants started up in 1990, with two others scheduled to come online in 1991. These four plants will produce a total of 110,000 metric tpy when completed. Consumption in Canada is expected to more than triple by 1995, primarily due to increasing demands in the oxygen delignification sector.

As 1990 drew to a close, there had not been a significant increase in oxygen prices in the previous four or five years (but that may change in the near future), and capacity appeared to be fairly well balanced in most markets. Nevertheless, some regional markets were showing a slight oversupply because of slumping steel industry consumption.

Besides oxygen delignification and oxygen addition to extraction bleaching stages (Eo), oxygen is also used in mill effluent treatment, recycling, and white liquor oxidation. In general, oxygen generation appeared to be trending away from cryogenics to the lower-cost and lower-purity PSA (air extraction) and membrane technologies, especially in the paper industry, where purity is not a critical factor.

In new developments, Union Camp Corp. announced it would use ozone to replace chlorine bleaching at its Franklin, Va., mill starting the second half of 1992. The process was also said to reduce mill effluent oxygen requirements as well as the color and quantity of bleach plant effluent.

Sodium chlorate (chlorine dioxide). Sodium chlorate is used in kraft pulp bleaching or can be converted to chlorine dioxide for the same purpose. Consumption of sodium chlorate grew to an estimated 1.5 million tons in 1990, which is 200,000 tons more than 1988 figures. The market was in good balance late in the year but could swing into oversupply in the future.

That would be due in part to several major paper mills that delayed or canceled plans to install ClO_2 generators and adopt high levels of ClO_2 substitution in their bleach plant operations. This, coupled with continued expansion by leading producers, put the market in a vulnerable position, according to some experts who felt that the environmentally driven growth could spell trouble for the industry in the long term.

ClO_2 was also feeling pressure from competitive technologies, such as H_2O_2 and oxygen, which continued to gain ground and perform well in various bleaching scenarios. The list price for sodium chlorate was firm at $400/ton (dry basis).

PAPERMAKING CHEMICALS

Alum. Paper industry alum sales continued to weaken as consumption in the U.S. declined about 1% to 3%. The chemical is used in acidic papermaking to precipitate rosin size onto pulp to make the finished paper water-resistant. Alum sales have been depressed in the wake of an alkaline conversion trend that has continued during the past three to five years. Between 30,000 and 50,000 tons have been lost to conversions during the past several years. But sales of iron-free alum were bolstered in some areas due to the demand for higher-quality newsprint.

Rising labor, transportation, and environmental costs prompted one of the few price increases in liquid alum in the past five years in the U.S. List prices for the technical grade rose $7 to $152/ton (dry basis) in September 1990, and the iron-free grade jumped to $267/ton. In Canada, alum prices rose in August by $7 to $11/ton, depending on the grade.

Alum was also reportedly feeling pressure from new product technology, such as polyaluminum chemistry. In new developments, Handy Chemicals (a subsidiary of Alcan Aluminum) opened the first industrial-scale plant for production of polymeric aluminum silicate sulfate (PASS). Although it has yet to prove its commercial viability, PASS is said to be a cost-effective replacement for alum and cationic polymers and can apparently be used in acid, neutral, and alkaline systems. Original production capacity for the facility was 60 million lb/year, with plans to double production during the third quarter.

Calcium carbonate. Calcium carbonate is a white pigment used as a coating and filler to improve paper brightness and opacity. Producers experienced soaring demand for both precipitated and ground grades in 1990, a trend that was expected to continue well into the middle of the decade. Ground carbonate consumption grew to an estimated 350,000 to 400,000 tons in 1990, an increase of more than 10%. Precipitated calcium carbonate (PCC) production, meanwhile, grew at 30%, with consumption increasing to an estimated 600,000 to 700,000 tons.

Onsite PCC plants continued to spring up, with 18 plants either online or under construction. Two more plants were in the final negotiation stages in North America, and an additional eight to ten were in various stages of approval worldwide. Scheduled startups of the North American projects ranged from late 1990 to early 1994. At these growth rates, U.S. and Canadian PCC consumption could easily top the 1.3-million-ton forecast for 1992, confirmed by producers earlier in 1990.

Another potentially lucrative market for calcium carbonate opened up as more lightweight coated (LWC) and specialty groundwood producers were reportedly running trials in the neutral-to-alkaline range. This movement was gaining momentum, particularly since Boise Cascade Corp. announced the first mill in North America to successfully produce such a sheet (in the neutral range) during the latter part of 1989.

Calcium carbonate producers (particularly ground) would benefit from such a trend and could possibly see another growth surge similar to that induced by alkaline conversions during the past several years. Interest was also strong in the supercalendered sector, where both grades of calcium carbonate were finding new uses.

Titanium dioxide. Paper industry consumption of TiO_2—another filler and coater—was between 240,000 and 250,000 tons, slightly more (0% to 1%) than 1989 figures. While boosted by coated paper markets, titanium consumption was hurt by the industry's conversion to alkaline paper. One producer estimated that 40,000 to 50,000 tons will be lost to conversions during the 1990-94 period.

Worldwide, the paper industry remained the second largest consumer of titanium (after paints) at about 15%, while that figure increased to 20% to 25% for the U.S. The market in general was soft, and prices had been stable for the last year and a half. List prices for rutile were in the $1.03 to $1.04 range, and anatase was selling for $1.00 to $1.01.

Major market expansions include a 60,000-tpy facility by Kerr McGee at a site to be determined; a 90,000-tpy expansion by DuPont at its DeLisle, Miss., plant (due online in 1991); and the first greenfield facility to be built in the U.S. since 1978, a 90,000-tpy plant by Kronos (formerly NL Chemicals) in Lake Charles, La. scheduled to start up in 1992.

CLAYS

Deep declines were seen in the demand for filler clays by the paper industry in 1990, although the losses were tempered by modest gains in the uncoated groundwood specialties sector. Conversion to alkaline systems by some major paper producers during the year caused a decrease in consumption by an estimated 10% to 12%.

While list prices remained unchanged at $515 to $545/ton (bags) and $505 to $509/ton (bulk) for calcined grades, actual prices declined because discounting was widespread. List prices for hydrous grades remained stable at $120 to $135/ton, while air-float grades remained at $40 to $55/ton.

Overall capacity remained even with the prior year's pace, so the general market was soft, with oversupply in many areas. The market slump dashed the hopes that producers could start up newly built calciners, scheduled to be online in 1990. Several producers had idle equipment.

Clays consumed in the coating segment had a better year than filler clays, increasing by about 2% to 3% and echoing the overall coated paper market growth of about 4%. Prices reportedly even rose slightly in some regions, while other producers reported no change. New developments in the LWC and groundwood specialties markets were the primary reasons for the year's success.

Kaolin pigments were finding niches in the "slightly coated" paper market, one of the many new grades being developed to fill the gap between uncoated and LWC paper. Both delaminated and calcined kaolins were being used in this area. Kaolin pigment producers were also developing new grades of pigments to find new market opportunities. One such class, structured pigments, was finding new uses in high-solids coating formulations.

WORLD REVIEW

For the seventh year in a row, output of pulp, paper, and board reached record levels in 1989, though the rate of growth slowed considerably from 1988. By mid-1990, growth in output was still positive, but the pace was sluggish. By year end, production levels were expected to surpass their 1989 levels only marginally.

The world made a total of 233,170,000 million tons of paper and board in 1989, a modest rise of 2.8% from the previous year. Pulp production reached 163,904,000 tons, up by an even more modest 1.8%. This means that pulp accounted for roughly 70% of the total furnish requirements of the industry.

Per capita consumption of paper and board edged up to 44.6 kg from an estimated 43.8 kg in 1988. This encouraging figure for the industry was also a new record and reflected a total apparent consumption level of 231,550,000 million tons, a rise of 2.9% from 1988.

As observed in previous years, just over one ton of paper and board in every five (around 22%) was traded across a national boundary. For pulp, the equivalent figure was 17%. Exports and imports were almost in balance: the gap for paper and board was 1.6 million tons, while it was 1.4 million tons for pulp.

A mixed year. The fortunes of the different continents were mixed in 1989. As has become the pattern in recent years, the most impressive growth rates came from Asia, while the performance of North America and Western Europe was generally less spectacular, but in line with the upward trend.

Latin America was the big disappointment of 1989, with massive problems of economic restructuring in several countries driving down demand for paper and board products. Africa, meanwhile, did relatively well, raising output slightly from 1988, despite its equivalent and persistent headaches of economic recession and indebtedness.

Western Europe's paper and board output crept tantalizingly close to the 60-million-ton mark. The 1989 total of 59.7 million tons represented a rise of 3.4% over 1988. The most noticeable performance was that of West Germany, where paper and board output passed 11 million tons for the first time, rising by 4.1%. West Germany also leapfrogged the U.S.S.R. to become the fifth-largest paper and board producer in the world in 1989.

For the Nordic nations, 1989 was a stable year, with most major producing companies turning their attention to investment in pulp and paper production facilities overseas. Output of paper and board rose by 2.4% and pulp by 2.2%. Finland's pulp output passed the 9-million-ton mark for the first time.

While Western Europe's pulp and paper industry was forging ahead, that of its Eastern neighbors was relatively static, with an estimated rise in paper and board output of just below 1% from 1988.

A slowing economy and destocking by paper users meant that the record run of output by the North American industry very nearly came to a halt. Output of paper and board rose by just 0.1% to its new high of 86,076 million tons. The two countries between them now make just under 37% of the world's paper and board, but their share is falling. In 1988, it was 37.8% and in 1987 it totaled almost 39%. North American pulp output in 1989 was 48.8% of the world total. And although no other continent comes near to this tonnage, North America's share of the world's total pulp production is also slipping: 48.8% in 1989 from 49.3% in 1988 and 49.9% in 1987.

Pearls of the Orient. Asia (excluding Australasia) accounts for nearly 23% of the world's output of paper and board, and the figure is rising year by year. In 1988, it was a fraction under 22%, and in 1987 it was just below 21%.

The 1989 total of 53.6 million tons was up 8% from 1988, slower than the 10% growth achieved in 1988. Last year was the first in which Asia's output crossed the 50-million-ton mark. The pulp and paper superpowers of the region—Japan, People's Rep. China, Rep. Korea, and Taiwan—are driving the growth. And they are being rapidly pursued by countries such as Indonesia and Thailand, where growth in demand is leading to rapid investment in new production capacity.

Japan continues to dominate both the consumption and production figures for the region. It makes 50%, or 26.8 million tons, of total paper and board output and consumes 47% of the 58.6 million tons used in Asia. In 1989, the nation's output and consumption figures rose by 8.9% and 9.6%, respectively. With an annual production of nearly 11 million tons of pulp, Japan is also the continent's dominant pulp producer, accounting for 46% of total output.

Asia's overall performance would probably have been even better if not for a slowdown in output growth in People's Rep. China. Political disturbances followed by economic recession limited paper and board expansion to 5.4% in 1988-89, compared with 8.1% in 1987-88 and 14.3% the year before. Nevertheless, People's Rep. China's massive output of 13.3 million tons of paper and board gives it fourth ranking among the world's leading producers, and its fast-rising production of pulp (9.3 million tons in 1989) is second only to Japan in Asia.

For Rep. Korea and Taiwan, 1989 was a disappointing year. Slowing, though still fairly rapid, economic growth and a shift away from the production of cheap commodity goods to more high-value-added products has also created oversupply in several grades of paper and board (mainly packaging grades), weakening the profitability of the major producers. Nevertheless, output rose sharply by 9.8% in Rep. Korea, smashing the 4-million-ton barrier for the first time. Taiwan's paper and board producers also demolished a psychological barrier, making more than 3 million tons for the first time, though the growth rate was only 3.1% from 1988.

New records were also set by Asia's emerging pulp and paper nations. Indonesian paper and board output broke through 1 million tons, while Thai demand did the same. Australasia also did well. Last year, the combined paper and board output of Asia and Australasia reached 56.3 million tons, up 7.8% from the 1988 combined total.

Doldrums in Latin America. Economic woes finally crushed the vitality out of some of the paper and board markets of Latin America in 1989. With many economies in the region implementing severe measures to counteract inflation, domestic demand was destined to be hit. Papermakers had the option to reduce their capacity utilization rates or to export more to neighboring countries. But with similar problems blighting many countries, the latter was not an easy option. The overall effect was that output of paper and board fell by 0.8% to 10.5 million tons. Apparent consumption fell by a similar amount.

Of course, the picture was not universally gloomy. Two countries in particular—Brazil and Mexico—both enjoyed considerable success. Brazil raised its paper and board output by 3.1% to 4.8 million tons, but a collapse in domestic demand in 1990 in response to new government economic

WORLD'S TOP 20 PRODUCING AND CONSUMING COUNTRIES, 1989

PAPER AND BOARD PRODUCTION (000 metric tons)			PULP PRODUCTION (000 metric tons)			PER CAPITA CONSUMPTION (lb/year)		
Country	1989	% change 1989/88	Country	1989	% change 1989/88	Country	1989	% change 1989/88
1. U.S.	69,532	0.2	1. U.S.	56,244	1.4	1. U.S.	669	-4.4
2. Japan	26,809	8.9	2. Canada	23,701	-0.4	2. Sweden	504	-26.4
3. Canada	16,544	-0.4	3. Japan	10,987	5.5	3. Japan	490	8.9
4. People's Rep. China	13,333	5.4	4. Sweden	10,338	0.6	4. Canada	490	-9.8
5. Fed. Rep. Germany	11,277	4.1	5. U.S.S.R.	10,100e	0.3	5. Switzerland	474	3.2
6. U.S.S.R.	11,000e	2.3	6. People's Rep. China	9,300	7.1	6. Finland	466	3.9
7. Finland	8,751	1.1	7. Finland	9,119	1.4	7. Fed. Rep. Germany	461	2.9
8. Sweden	8,362	2.7	8. Brazil	4,501	4.9	8. Denmark	450	1.3
9. France	6,754	7.0	9. Fed. Rep. Germany	2,418	2.5	9. Netherlands	448	4.5
10. Italy	5,600	1.6	10. France	2,273	3.8	10. Belgium	435	1.3
11. Brazil	4,831	3.1	11. Norway	2,189	14.2	11. Australia	378	10.5
12. U.K.	4,476	4.2	12. South Africa	1,840e	2.3	12. U.K.	371	3.1
13. Rep. Korea	4,018	9.8	13. Spain	1,707	2.5	13. Luxembourg	355e	n.a.
14. Spain	3,445	1.1	14. Austria	1,502	3.2	14. New Zealand	350	1.4
15. Taiwan	3,042	3.2	15. Portugal	1,482	0.7	15. Taiwan	347	3.1
16. Austria	2,754	3.9	16. New Zealand	1,259	3.9	16. Hong Kong	342e	5.9
17. Mexico	2,737	5.6	17. Czechoslovakia	1,120	-0.2	17. Austria	339	6.5
18. Netherlands	2,572	4.5	18. Australia	1,061	1.0	18. France	328	5.0
19. India	2,185	9.3	19. India	1,050e	0.0	19. Norway	316	-5.0
20. Australia	1,954	5.4	20. Poland	860	-6.6	20. Italy	258	8.0

e = Estimate.
Source: *Pulp & Paper International.*

REVIEW OF TOP 20 NATIONS IN PULP/PAPER PRODUCTION

Australia

Population: 16,549,000. Per capita consumption of paper and board: 172 kg. Paper and board mills: 18. Pulp mills: 19 (sulfate: 2; sulfite: 1; soda: 2; semichemical: 5; mechanical: 8; nonwood: 1).

Paper/board capacity: 2,395,000e tons **Pulp capacity:** 1,295,000e tons

	Production		**Imports**		**Exports**	
	1988	**1989**	**1988**	**1989**	**1988**	**1989**
Paper	803	881	800	819	110	12
Board	1,051	1,073	—	197	—	114
Total	**1,854**	**1,954**	**800e**	**1,016**	**110**	**126**
Chemical woodpulp	469	524	280	256	80	60
Mechanicals, other pulps	582	537	0	6	0	0
Total	**1,051**	**1,061**	**280**	**262**	**80**	**60**

Austria

Population: 7,614,000. Per capita consumption of paper and board: 153.9. Paper and board mills: 33. Pulp mills: 11 (sulfate: 3; sulfite: 4; semichemical: 1; mechanical: 4).

Paper/board capacity: 3,384,000 tons **Pulp capacity:** 1,853,000 tons
Operating rate 1989: 90% **Operating rate 1989:** 87%

	Production		**Imports**		**Exports**	
	1988	**1989**	**1988**	**1989**	**1988**	**1989**
Paper	2,259	2,359	347.	405	1,692	1,767
Board	391	395	70	72	292	292
Total	**2,650**	**2,754**	**417**	**477**	**1,984**	**2,059**
Chemical woodpulp	1,045	1,067	381	374	260	244
Mechanicals, other pulps	410	435	24	21	2	0
Total	**1,455**	**1,502**	**405**	**395**	**262**	**244**
Market pulp	363	370	405	395	262	244

Brazil

Population: 147,850,000. Per capita consumption of paper and board: 28.6 kg. Paper and board mills: 146. Pulp mills: 38 (sulfate: 17; sulfite: 3; semichemical: 3; soda: 6; mechanical: 44; nonwood: 9).

Paper/board capacity: 5,457,000 tons **Pulp capacity:** 4,913,000 tons

	Production		**Imports**		**Exports**	
	1988	**1989**	**1988**	**1989**	**1988**	**1989**
Paper	4,237	4,343	188	237	956	866
Board	447	488	3	5	49	51
Total	**4,684**	**4,831**	**191**	**242**	**1,005**	**917**
Chemical woodpulp	3,713	3,884	55	81	1,052	996
Mechanicals, other pulps	579	617	3	3	12	7
Total	**4,292**	**4,501**	**58**	**84**	**1,064**	**1,003**
Market pulp	1,731	1,618	51	75	1,064	1,003

Canada

Population: 26,315,000. Per capita consumption of paper and board: 248.3. Paper and board mills: 110. Pulp mills: 34

Paper/board capacity: 18,684,000 tons **Pulp capacity:** 26,030,000 tons
Operating rate 1989: 89% **Operating rate 1989:** 95%

	Production		**Imports**		**Exports**	
	1988	**1989**	**1988**	**1989**	**1988**	**1989**
Paper	15,894	15,815	683	723	11362	11,551
Board	723	729	267	242	68	101
Total	**16,617**	**16,544**	**950**	**965**	**11,430**	**11,652**
Chemical woodpulp	13,360	13,182	176	173	7,723	7,395
Mechanicals, other pulps	10,441	10,519	4	6	677	957
Total	**23,801**	**23,701**	**180**	**179**	**8,400**	**8,352**
Market pulp	7,226	7,091	180	179	8,400	8,352

China, People's Rep.

Population: 1,111,910,000. Per capita consumption of paper and board: 12.6 kg. Paper and board mills: 5,000. Pulp mills: 9,000.

Paper/board capacity: 15,500,000e tons **Pulp capacity:** 11,000,000e tons

	Production		**Imports**		**Exports**	
	1988	**1989**	**1988**	**1989**	**1988**	**1989**
Paper	334	383	102	101	7	4
Board	12,311	12,950	750	761	261	222
Total	**12,645**	**13,333**	**852**	**862**	**268**	**226**
Chemical woodpulp	1,045	1,032	746	437	8	2
Mechanicals, other pulps	6,550	7,203	49	39	6	7
Reed and bagasse	938	933	—	—	—	—
Total	**8,533**	**9,300**	**795**	**476**	**14**	**9**
Market pulp	200	220	795	476	14	9

Finland

Population: 4,961,000. Per capita consumption of paper and board: 212 kg. Paper and board mills: 46. Pulp mills: 46 (sulfate: 18; sulfite: 3; semichemical: 3; mechanical: 22).

Paper/board capacity: 9,335,000 tons **Pulp capacity:** 9,630,000 tons
Operating rate 1989: 94% **Operating rate 1989:** 97%

	Production		**Imports**		**Exports**	
	19887	**1989**	**1988**	**1989**	**1988**	**1989**
Paper	7,412	7,502	74	89	6,170	6,257
Board	1,242	1,249	30	32	1,015	1,040
Total	**8,654**	**8,751**	**104**	**121**	**7,185**	**7,297**
Chemical woodpulp	5,603	5,752	27	19	1,491	1,468
Mechanicals, other pulps	3 391	3,367	46	63	190	184
Total	**8,994**	**9,119**	**73**	**82**	**1,681**	**1,652**
Market pulp	2,108	2,073	73	82	1,681	1,652

France

Population: 55,984,000. Per capita consumption of paper and board: 149.3 kg. Paper and board mills: 146. Pulp mills: 20 (sulfate: 7; sulfite: 2; semichemical: 1; mechanical: 10).

Paper/board capacity: 6,860,000 tons **Pulp capacity:** 2,545,000 tons
Operating rate 1989: 98% **Operating rate 1989:** 89%

	Production		**Imports**		**Exports**	
	1988	**1989**	**1988**	**1989**	**1988**	**1989**
Paper	5,707	6,148	2,921	2,991	1,676	1,828
Board	606	606	570	650	194	210
Total	**6,313**	**6,754**	**3,491**	**3,641**	**1,870**	**2,038**
Chemical woodpulp	1,655	1,727	1,689	1,697	405	358
Mechanicals, other pulps	535	549	56	56	—	—
Total	**2,190**	**2,273**	**1,745**	**1,753**	**405**	**358**
Market pulp	754	731	1,745	1,753	405	358

Germany, Fed Rep.

Population: 62,400,000. Per capita consumption of paper and board: 209.7 kg. Paper and board mills: 174. Pulp mills: 34 (semichemical: 1; mechanical: 23).

Paper/board capacity: 12,114,000 tons **Pulp capacity:** 2,573,000 tons
Operating rate 1989: 93% **Operating rate 1989:** 100%

	Production		**Imports'**		**Exports**	
	1988	**1989**	**1988**	**1989**	**1988**	**1989**
Paper	9,642	10,081	5,062	5,289	3,442	3,690
Board	1,189	1,196	509	566	338	357
Total	**10,831**	**11,277**	**5,571**	**5,855**	**3,780**	**4,047**
Chemical woodpulp	850	874	3,235	3,424	191	167
Mechanicals, other pulps	1,508	1,544	98	112	11	16
Total	**2,358**	**2,418**	**3,333**	**3,536**	**202**	**183**
Market pulp	279	272	3,333	3,536	202	183

measures may well have reversed the growth trend. Much depends on producers' ability to penetrate export markets. Mexico's 1989 success, with output of paper and board rising by 5.6%, looked more certain to be sustained. Corrective deflationary economic policies were introduced there and appeared to be highly successful.

Latin America's pulp production in 1989 rose by 1.2% to 7.4 million tons. With market pulp demand running high worldwide, Brazil, Chile, and Argentina enjoyed a relatively successful year. Brazil's pulp output rose by 4.9% to cross 4.5 million tons for the first time. However, rougher times may be ahead for the country's pulp producers, especially since a large volume of new capacity is set to come onstream in a weaker market.

Africa's fortunes improved some in 1989, with total paper and board output approaching 2.7 million tons and pulp production static at about 2.4 million tons. South Africa holds the key to this region. Its producers make about 71% of the entire continent's paper and board and nearly 77% of its pulp. A South African company controls the 180,000-tpy pulp mill in Swaziland, so the South African share of total African pulp production was about 83% in 1989.

The outlook is patchy. Each of the major regions faces its own particular set of problems in 1990. In Western Europe, economic deceleration combined with a buildup of production capacity, especially for printing papers, is set to cut producers' profits. But the underlying trend in demand remains strong and growing. The Nordic countries will continue to be major suppliers of key grades to the European continent.

In Eastern Europe, 1990 could well turn out to be a bleak year. Economic reform in Poland, Yugoslavia, Hungary and Czechoslovakia, and the U.S.S.R. may have a negative impact on demand in the short term, although ultimately these countries should provide one of the world's liveliest markets.

In Asia and Australasia, Japan's economy seems unstoppable and is expected to post a 4% gain in GNP this year. That is bound to mean another year of soaring pulp, paper, and board demand. For People's Rep. China, growth in demand and output will continue but at a reduced rate compared with the 1980s. Rep. Korea and Taiwan will also have to be content in the short term with more modest, but still fairly high, consumption and production growth rates, while in Indonesia and Thailand growth rates in demand of well over 10%/year are possible for the next few years.

With Brazil and Argentina in economic turmoil, Latin America's paper and board production may well be badly affected in 1990. Slower growth in pulp demand and output can also be forecast.

Finally, Africa looks likely to continue to make slow progress through 1990, but its long-term future will hinge on the success of the few pulp and paper producing firms in South Africa.

AFRICA

Paper and board output in Africa rose just 2.8% to 2.7 million tons in 1989, and pulp dropped off slightly to 2.4 million tons. South Africa dominates the African paper industry, and considerable activity is unfolding in that country.

A new massive wave of investment is proceeding in South Africa, only five years after the opening of major greenfield mills by the industry's two largest companies, Mondi and Sappi. In addition, there has been further rationalization of an already streamlined company ownership pattern. More notably still, the South African pulp and paper producers have begun to invest in production facilities outside their own frontiers.

Sappi, the top pulp and paper producer in Africa, took over a controlling interest in the former Southern African pulp interests of the U.K. group Courtaulds. That included a 75% share of the 400,000-tpy Saiccor dissolving pulp mill and a 50% holding in the Usutu Pulp Mill in Swaziland, which has a capacity of 180,000 tpy of unbleached kraft softwood pulp and has been operating at high capacity utilization for many years. More recently, Sappi went on the acquisition trail further afield, buying no less than five paper mills in the U.K. This move will partly integrate some of Sappi's market pulp capacity.

Sappi's rival Mondi Paper meanwhile has been expanding its capacity in a $160-million program. The result was a paper capacity increase of 130,000 tpy. Half of the investment was directed at raising capacity of supercalendered papers at the Merebank mill by 45% to 127,000 tpy. Pulp capacity at Richards Bay is also being raised to 420,000 tpy.

ASIA/AUSTRALASIA

Output of paper and board in Asia/Australasia climbed 7.8% in 1989 to 56.3 million tons. Pulp production reached 26.3 million tons, a rise of 6.5%.

Japan maintains its preeminence in the region. The country's paper and board production in 1989 set a new record of 26.8 million tons, up 8.9% compared with the previous year. This figure included 15.7 million tons of paper, up 9.6% compared with output in 1988, and 1.1 million tons of board, an increase of 7.8% on the previous year. Output of printing and writing grew by 14.9%, and corrugated containers rose 10.7%.

Domestic sales of paper and board in 1989 reached a record level of 26.1 million tons, 8.8% higher than 1988, while actual GNP rose 4.9%. The fastest-growing grades were printing and writing and corrugated containers.

Exports, mainly to People's Rep. China and Southeast Asia, decreased by 15% compared with the previous year. This was caused by strong domestic demand and foreign competition.

Imports totaled 1.2 million tons, 12.3% above 1988, boosted by the growth of newsprint and printing/writing in particular.

Japan's trade balance for paper and paperboard recorded a deficit in 1986 that has steadily increased over the past four years. The main suppliers of imports are North America and Northern Europe, with U.S. products accounting for 43% of Japan's total imports.

The rise in paper and board production pushed up de-

REVIEW OF TOP 20 NATIONS IN PULP/PAPER PRODUCTION (continued)

India

Population: 835,240,000. Per capita consumption of paper and board: 2.9. Paper and board mills: 310. Pulp mills: 210.

Paper/board capacity: 3,014,000 tons **Pulp capacity:** 1,450,000e tons

	Production		**Imports**	
	1988	**1989**	**1988**	**1989**
Paper	1,220	1,385	229	255
Board	780	800	0	0
Total	**2,000**	**2,185**	**229**	**255**
Total pulp	**1,050e**	**1,050e**	**300e**	**300e**
Market pulp	30e	30e	300e	300e

Italy

Population: 57,368,000. Per capita consumption of paper and board: 117.1 kg. Paper and board mills: 335. Pulp mills: 21 (sulfite: 2; semichemical: 3; mechanical: 15; nonwood: 1).

Paper/board capacity: 6,150,000 tons **Pulp capacity:** 1,080,000 tons

	Production		**Imports**		**Exports**	
	1988	**1989**	**1988**	**1989**	**1988**	**1989**
Paper	4,482	1,031	1,941	2,234	1,033	1,044
Board	1,030	1,031	208	258	276	330
Total	**5,512**	**5,600**	**2,149**	**2,492**	**1,309**	**1,374**
Chemical woodpulp	230	214	2,017	2,019	48	55
Mechanicals, other pulps	559	562	130	162	8	13
Total	**789**	**776**	**2,147**	**2,181**	**56**	**68**
Market pulp	270	260	2,147	2,181	56	68

Japan

Population: 123,260,000. Per capita consumption of paper and board: 222.7 kg. Paper and board mills: 486. Pulp mills: 58 (sulfate: 37; sulfite: 3; semichemical: 8; mechanical: 24; nonwood: 2).

Paper/board capacity: 28,847,000 tons **Pulp capacity:** 13,475,000 tons
Operating rate 1989: 93% **Operating rate 1989:** 82%

	Production		**Imports**		**Exports**	
	1988	**1989**	**1988**	**1989**	**1988**	**1989**
Paper	21,446	23,594	951	1,060	491	421
Board	3,178	3,215	96	115	145	119
Total	**24,624**	**26,809**	**1,047**	**1,175**	**636**	**540**
Chemical woodpulp	8,251	8,809	2,623	2,920	13	10
Mechanicals, other pulps	2,164	2,178	467	444	0	1
Total	**10,415**	**10,987**	**3,090**	**3,364**	**13**	**11**
Market pulp	917	956	3,090	3,364	13	11

Korea, Rep.

Population: 42,380,000. Per capita consumption of paper and board: 91.2 kg. Paper and board mills: 150. Pulp mills: 5 (sulfate: 1; mechanical: 4).

Paper/board capacity: 4,674,000 tons **Pulp capacity:** 400,000 tons

	Production		**Imports**		**Exports**	
	1988	**1989**	**1988**	**1989**	**1988**	**1989**
Paper	2,907	3,236	183	261	155	125
Board	752	782	5	13	249	301
Total	**3,659**	**4,018**	**188**	**274**	**404**	**426**
Chemical woodpulp	155	157	823	897	0	0
Mechanicals, other pulps	158	145	82	62	0	0
Total	**313**	**302**	**905**	**959**	**0**	**0**
Market pulp	155	157	905	959	0	0

Mexico

Population: 86,573,000. Per capita consumption of paper and board: 31.3. Paper and board mills: 67. Pulp mills: 15 (sulfate: 8; mechanical: 2; nonwood: 5).

Paper/board capacity: tons **Pulp capacity:** tons

	Production		**Imports**		**Exports**	
	1988	**1989**	**1988**	**1989**	**1988**	**1989**
Paper	2,323	2,425	128	150	239	188
Board	270	312	15	23	13	13
Total	**2,593**	**2,737**	**143**	**173**	**252**	**201**
Chemical woodpulp	433	414	313	283	48	31
Bagasse	247	259	—	—	—	—
Mechanicals, other pulps	118	126	43	44	4	0
Total	**798**	**799**	**356**	**327**	**52**	**31**

Netherlands

Population: 14,832,000. Per capita consumption of paper and board: 202.7 kg. Paper and board mills: 32. Pulp mills: 3 (mechanical: 2, nonwood: 1).

Paper/board capacity: 2,748,000 tons **Pulp capacity:** 198,000 tons
Operating rate 1989: 94% **Operating rate 1989:** 84%

	Production		**Imports**		**Exports**	
	1988	**1989**	**1988**	**1989**	**1988**	**1989**
Paper	1,721	1,785	1,695	1,813	1,221	1,241
Board	741	787	399	379	462	505
Total	**2,462**	**2,572**	**2,094**	**2,192**	**1,683**	**1,746**
Chemical woodpulp	0	0	598	584	22	6
Mechanicals, other pulps	184	167	23	42	4	1
Total	**184**	**167**	**621**	**626**	**26**	**7**

Spain

Population: 39,260,000. Per capita consumption of paper and board: 104.7 kg. Paper and board mills: 160. Pulp mills: 27 (sulfate: 17; sulfite: 1; semichemical: 1; mechanical: 5; nonwood: 3).

Paper/board capacity: 3,650,000 tons **Pulp capacity:** 1,740,000 tons

	Production		**Imports**		**Exports**	
	1988	**1989**	**1988**	**1989**	**1988**	**1989**
Paper	3,039	3,093	913	1,113	367	392
Board	369	352	14	24	71	80
Total	**3,408**	**3,445**	**927**	**1,137**	**438**	**472**
Chemical woodpulp	1,446	1,491	410	310	535	534
Mechanicals, other pulps	220	216	12	14	12	17
Total	**1,666**	**1,707**	**422**	**324**	**547**	**551**
Market pulp	731	774	422	324	547	551

Sweden

Population: 8,354,000. Per capita consumption of paper and board: 245 kg. Paper and board mills: 54. Pulp mills: 54 (sulfate: 24; sulfite: 7; semichemical: 2; mechanical: 21).

Paper/board capacity: 9,075,000 tons **Pulp capacity:** 11,205,000 tons

	Production		**Imports**		**Exports**	
	1987	**1989**	**1988**	**1989**	**1988**	**1989**
Paper	6,864	6,990	196	201	5,420	5,509
Board	1,279	1,372	79	70	1,192	1,210
Total	**8,143**	**8,362**	**275**	**271**	**6,612**	**6,719**
Chemical woodpulp	7,123	7,037	103	108	2,407	2,258
Mechanicals, other pulps	3,152	3,301	32	31	705	655
Total	**10,275**	**10,338**	**135**	**139**	**3,112**	**2,913**
Market pulp	3,662	3,669	135	139	3,112	2,913

REVIEW OF TOP 20 NATIONS (continued)

Taiwan

Population: 20,127,000. Per capita consumption of paper and board: 157.5 kg. Paper and board mills: 155. Pulp mills: 4 (sulfate: 2; mechanical: 1; nonwood: 1).

Paper/board capacity: 3,650,000e tons **Pulp capacity:** 500,000e tons

	Production		Imports		Exports	
	1988	**1989**	**1988**	**1989**	**1988**	**1989**
Paper	2,282	2,332	335	415	146	169
Board	667	710	8	17	101	129
Total	**2,949**	**3,042**	**343**	**432**	**247**	**298**
Chemical woodpulp	350	377	448	454	86	75
Bleached bagasse	73	59	—	—	14	17
Mechanical, other pulps	2	1	74	44	1	1
Total	**425**	**437**	**522**	**498**	**101**	**93**

United Kingdom

Population: 56,890,000. Per capita consumption of paper and board: 168.5 kg. Paper and board mills: 91. Pulp mills: 7 (semichemical: 2; mechanical: 3; nonwood: 2).

Paper/board capacity: 4,993,000 tons **Pulp capacity:** 564,000 tons
Operating rate 1989: 91% **Operating rate 1989:** 80%

	Production		Imports		Exports	
	1988	**1989**	**1988**	**1989**	**1988**	**1989**
Paper	4,295	4,476	5,788	6,014	798	905
Board	0	0	0	0	0	0
Total	**4,295**	**4,476**	**5,788**	**6,014**	**798**	**905**
Chemical woodpulp	145	151	1,851	1939	1	2
Mechanicals, other pulps	276	295	237	202	7	8
Total	**421**	**446**	**2,088**	**2,141**	**8**	**10**
Market pulp	0	0	0	0	0	0

United States

Population: 249,900,000. Per capita consumption of paper and board: 302 kg. Paper and board mills: 544. Pulp mills: 215 (sulfate and soda: 199; sulfite: 18; semichemical: 35; mechanical: 57).

Paper/board capacity: 74,793,000 tons **Pulp capacity:** 58,322,000 tons
Operating rate 1989: 93% **Operating rate 1989:** 96%

	Production		Imports		Exports	
	1988	**1989**	**1988**	**1989**	**1988**	**1989**
Paper	52,570	52,505	11,133	11,130	2,235	2,517
Board	16,801	17,027	78	77	2,070	2,268
Total	**69,371**	**69,532**	**11,211**	**11,207**	**4,305**	**4,785**
Chemical woodpulp	48,801	50,550	4,097	3,591	4,256	5,622
Mechanicals, other pulps	6,684	5,694	474	949	759	31
Total	**55,485**	**56,244**	**4,571**	**4,540**	**5,015**	**5,653**
Market pulp	7,770	7,860	3,149	3,030	4,600	4,817

U.S.S.R.

Population: 285,951,000. Per capita consumption of paper and board: 35.9 kg. Paper and board mills: 173. Pulp mills: 54 (sulfate: 21; sulfite: 34; semichemical: 7).

Paper/board capacity: 11,500,000e tons **Pulp capacity:** 11,000,000e tons

	Production		Imports		Exports	
	1988	**1989**	**1988**	**1989**	**1988**	**1989**
Paper	9,500	9,750	235	235	1,205	1,245
Board	1,250	1,250	—	—	—	—
Total	**10,750**	**11,000**	**575**	**575**	**1,300**	**1,320**
Chemical woodpulp	7,225	7,260	216	230	1,100	1,100
Mechanicals, other pulps	2,840	2,840	4	0	—	—
Total	**10,065**	**10,100**	**220**	**230**	**1,100**	**1,100**
Market pulp	3,250	3,250	220	230	1,100	1,100

mand for pulp in 1989. Output was up 5.5% on the previous year, at 11 million tons, some 60% of which was bleached sulfate pulp. Pulp imports totaled 3.1 million tons, 10.4% more than in 1988. Bleached sulfate accounted for 78%, or 2.4 million tons, of those pulp imports. North America was the main supplier, providing 77% of Japan's total pulp imports.

Wastepaper accounted for 50% of the industry's raw fiber supply in 1989. Consumption reached a record level of 13.5 million tons, up 8.5% on the previous year. Most of the demand for wastepaper depends on domestic supplies. Japan's recovery rate in 1989 was 48.2%, 0.3% higher than the rate in 1988.

Growth in the paper and board industry in People's Rep. China slowed considerably from 1988, when production surged almost 11%. People's Rep. China's paper and board production totaled 13.3 million tons in 1989, an increase of more than 5% compared with the previous year. Pulp output was an estimated 9.3 million tons, up 6.6% compared with 1988.

In a country with a population of 1,110 million, paper and board production is expected to reach 19 million tpy by the end of the century. If that target is to be met, structural reforms, environmental improvements, and more raw materials will be needed. Greenfield pulp mills will be particularly important in the future.

People's Rep. China already ranks fourth among the world's major paper producers, but consumption per capita is still only 25.3 lb, far below the world average of 97 lb, and the gap between supply and demand is growing.

The industry's shortage of fiber, one of the stumbling blocks to increasing output, should be eased by a massive state forestation program. It plans to expand People's Rep. China's forest area from its present 12% coverage of the land base to 20% by 2000. In addition, wastepaper consumption grew from 700,000 tons in 1985 to 3 million tons in 1988.

The economy in Rep. Korea—the third largest paper producer in Asia—advanced significantly between 1986-88, recording growth of more than 12% in three consecutive years. But an economic slowdown began at the outset of 1989, with real GNP growth dropping to 6.7%, the lowest since 1982.

However, the paper industry has benefitted from political changes beginning in June 1987 that have led to an upsurge of new and revived publications. These, together with increased newspaper pagination, have boosted the Republic's demand for newsprint significantly. Consequently, the country's newsprint output increased by some 21% in 1989, and producers reported record profits.

Tissue grades also performed well. Production rose by 25% compared with the previous year, and profits reached a record high. The tissue sector is currently in a major period of expansion, backed by a strong increase in demand.

Printing and writing grades suffered declining profits, although demand increased moderately. About 190,000 tons of new capacity was added during 1989 in this sector. Packaging grades continued to be plagued by oversupply in 1989.

Taiwan's paper output finally exceeded the 3-million-tpy mark in 1989 to total 3.04 million tons. But the production growth rate of 3.1% was considerably less than expected and was also lower than the 7.8% increase in 1988. In addition, production grew at a slower pace than GNP at 7.46%.

Increased imports—encouraged by the appreciation of local currency against the U.S. dollar—were a contributing factor in the industry's sluggish performance in 1989.

There were two major structural changes to Taiwan's industry in 1989. Union Paper was taken over by Yuen Feng Yu Paper, and Pao Lung's lease arrangement with Cheng Loong was terminated.

The Indian paper industry made a recovery in 1989 after two difficult years. The paper industry grew 2.5%, compared with 1.9% in 1988. And in general, India's economy is now in fairly good shape, showing 5.5% GDP growth in 1989.

But production costs for the paper industry, such as energy, coal, chemicals, and raw materials, steadily increased. In addition, a shortage of conventional fiber continued throughout the year. Liberalized imports of bleached and unbleached pulps and wastepaper from Western countries averted the closure of several small- and medium-size paper mills and helped boost production of paper and board in general. The industry was also boosted by two general price rises in 1989.

The overall capacity utilization of the industry is reportedly just 60%, but most of the large and medium-size mills operated at more than 80% of capacity last year. The low total capacity utilization is due to the mushrooming growth of small mills, many with secondhand paper machines imported a decade ago to meet the acute paper shortage at that time.

Indonesian paper and board capacity exceeded 1 million tons for the first time in 1988 and, by the end of 1990, was expected to be close to 2 million tons. Since capacity is growing faster than consumption, producers are increasingly targeting overseas markets to sell a large part of their output.

Fayar Surya Wisesa is one example. The firm began production on No. 1 paper machine at its new Bekasi mill with a capacity of 80,000 tpy of corrugating medium and liner, using 20% to 30% imported kraft pulp during 1989. A few months later, in September, the company started up a second machine at the site for the production of 200 to 250 tpd of coated duplex board. The machine uses around 20% imported pulp, as well as old corrugated containers and deinked old newspapers. Some 30% to 40% of output is destined for export.

Thailand's economy grew 11% in 1989 for the second consecutive year, with exports for the first ten months some 30% ahead of the same period in 1988. The paper industry reflected the general boom of the economy, and consumption exceeded 1 million tons for the first time. The fastest-growing grades were packaging papers and board, expanding 20%/year from 1987-89. Newsprint and printing and writing papers were less robust, reporting growth rates of 7% to 8% over the same period.

A healthy growth rate of around 10%/year is forecast for paper and board demand over the next few years, with per capita consumption rising from the current 40 lb to around 88 lb by the year 2000. Demand is expected to amount to 2 million tpy before the end of the century.

Capacity will also rise. Most new capacity, some 800,000 tpy of it, will be in packaging grades, an increase of around 180% in this sector. However, even if domestic demand grows at 20%/year over the next four years, new investment will exceed demand significantly, and the market will be heavily oversupplied.

This prospect does not seem to have quelled enthusiasm for new capital investment projects. Hiang Seng Fibre, for example, is spending around $230 million on a greenfield pulp and paper mill in Ayuthaya, some 60 km from Bangkok. The new project, to be called Panjapol Paper, was scheduled to start up at the end of 1990 with an initial capacity of 850 tpd of multi-ply unbleached and white-top linerboard and unbleached multi-wall sack kraft paper. Its new pulp line was to have a capacity of 275 tpd of softwood kraft and bamboo-based pulp.

In New Zealand, total output of pulp and paper in 1989 increased 2.2% and 5.3%, respectively. Wood supply from New Zealand's plantation forests is expected to double over the next decade as a result of a planting boom in the 1960s. This presents massive opportunities for further expansion of the processing sector. A study undertaken for the New Zealand Forestry Corp., which controls half of the plantation resource, suggests that it will have sufficient fiber for one or two new kraft pulp mills and two or three new paper mills.

From mid-1988 to mid-1989, consumption of paper and board in Australia rose 5.7%. However, local production was up only 4.2%, while imports grew by 8.3%. And fears are mounting that Australia's natural target for exports, the Pacific Rim, looks set to become its strongest competitor in the future.

Nevertheless, domestic expansion is going forward, with two greenfield straw-based pulp mills due to start up within the next few years. Riverhouse intends to build a 100,000-tpy mill in Moora that is set to start up in third-quarter 1992. Arisa has plans to start up a 95,000-tpy unbleached straw pulp mill in South Australia in the same year.

The major structural change in the industry was Elders-IXL's decision to divest its papermaking operations and sell off the New Zealand-based NZFP group to Carter Holt Harvey.

EUROPE

Total paper and board output in Europe grew 2.8% to 77.6 million tons in 1989. Output in western Europe, including the Nordic countries, edged up 3.4% to 59.7 million tons. Eastern Europe was unable to keep growth above 1%, ending with 18.0 million tons for the year. Apparent consumption for the whole continent reached 73.4 million tons, an increase of 3.3%. Per capita consumption hit 206 lb, though western consumers averaged 347 lb, and easterners used just 88 lb per person.

Country	Population (1,000)	Number of mills P&B	Number of mills Pulp	Capacity (1,000 tons) P&B	Capacity (1,000 tons) Pulp	Per capita (kg)	Apparent consumption (1,000 tons) P&B 1988	Apparent consumption P&B 1989	Apparent consumption Pulp 1988	Apparent consumption Pulp 1989	Production (1,000 tons) P&B 1988	Production P&B 1989	Production Pulp 1988	Production Pulp 1989
EUROPE														
Belgium	9,933	17	3	1,200	463	197.9	1,939	1,966	771	790	1,137	1,167	449	467
Denmark	5,134	6	2	340	102	204.7	1,034	1,051	133	142	343	328	95	105
France	55,984	148	20	6,860	2,545	149.3	7,934	8,357	3,530	3,668	6,313	6,754	2,190	2,273
Germany, Fed. Rep.	62,400	174	34	12,114	2,573	209.7	12,622	13,085	5,489	5,771	10,831	11,277	2,358	2,418
Greece	10,039	25	2	500	75	67.7	650	680	255	240	375	375	65	40
Ireland	3,646	1	0	40	0	87.2	309	318	0	0	34	33	0	0
Italy	57,368	335	21	6,150	1,080	117.1	6,352	6,718	2,880	2,889	5,512	5,600	789	776
Luxembourg	372	0	0	0	0	161.3	57	60	0	0	0	0	0	0
Netherlands	14,832	32	3	2,748	198	203.5	2,873	3,018	779	786	2,462	2,572	184	167
Portugal	10,316	90	8	833	1,450	67.8	664	699	422	486	681	740	1,472	1,482
Spain	39,260	160	27	3,650	1,740	104.7	3,897	4,110	1,541	1,480	3,408	3,445	1,686	1,707
United Kingdom	56,890	91	7	4,993	564	168.5	9,285	9,585	2,501	2,577	4,295	4,476	421	446
EEC	**326,174**	**1,077**	**127**	**39,428**	**10,790**	**152.2**	**47,616**	**49,647**	**18,301**	**18,829**	**35,391**	**36,767**	**9,689**	**9,881**
Finland	4,961	46	46	9,335	9,630	317.5	1,573	1,575	7,386	7,549	8,654	8,751	8,994	9,119
Norway	4,212	19	23	1,900	2,200	143.6	635	605	1,359	1,620	1,670	1,790	1,917	2,189
Sweden	8,354	54	54	9,075	11,205	229.1	1,806	1,914	7,298	7,564	8,143	8,362	10,275	10,338
Nordic	**17,527**	**119**	**123**	**20,310**	**23,035**	**233.6**	**4,014**	**4,094**	**16,043**	**16,733**	**18,467**	**18,903**	**21,186**	**21,646**
Austria	7,614	33	11	3,384	1,853	153.9	1,083	1,172	1,598	1,653	2,650	2,754	1,455	1,502
Iceland	251	0	0	0	0	103.6	26	26	0	1	0	0	0	0
Malta	349	0	0	0	0	71.6	25	25	0	0	0	0	0	0
Switzerland	6,673	29	6	1,300	360	215.3	1,370	1,437	634	630	1,216	1,259	335	328
Other W. Europe	**14,887**	**62**	**17**	**4,684**	**2,213**	**178.7**	**2,504**	**2,660**	**2,232**	**2,284**	**3,866**	**4,013**	**1,790**	**1,830**
Total W. Europe	**358,588**	**1,258**	**267**	**64,422**	**36,038**	**157.3**	**54,134**	**56,401**	**36,576**	**37,846**	**57,724**	**59,683**	**32,665**	**33,357**
Albania	3,194	4	4	15e	15e	4.7	15	15	10	10	10	10	10	10
Bulgaria	9,000	15	9	520e	260e	45.6	440	410	270	270	350	350	220	220
Czechoslovakia	15,661	36	23	1,261	1,223	78.7	1,220	1,233	919	915	1,259	1,273	1,122	1,120
German Dem. Rep.	16,500	21	19	1,500e	750e	85.6	1,395	1,413	835	849	1,362	1,360	690	669
Hungary	10,579	9	4	515	123	61.7	688	653	292	245	535	504	81	73
Poland	38,173	47	20	1,600	1,050	35.1	1,431	1,340	1,110	1,038	1,444	1,397	921	860
Romania	23,048	15	12	905	953	24.9	585	573	738	716	734	709	687	665
USSR	285,951	173	54	11,500e	11,000e	35.9	10,025	10,255	9,185	9,230	10,750	11,000	10,065	10,100
Yugoslavia	23,713	30	21	1,500	900	46.2	1,133	1,095	943	968	1,377	1,360	837	846
E. Europe	**425,819**	**350**	**166**	**19,316**	**16,274**	**39.9**	**16,932**	**16,987**	**14,302**	**14,241**	**17,821**	**17,963**	**14,633**	**14,563**
Total Europe	**784,407**	**1,608**	**433**	**83,738**	**52,312**	**93.6**	**71,066**	**73,388**	**50,878**	**52,087**	**75,545**	**77,646**	**47,298**	**47,920**
NORTH AMERICA														
Canada	26,315	110	34	18,684	26,030	222.6	6,137	5,857	15,581	15,528	16,617	16,544	23,801	23,701
USA	249,900	544	215	74,793	58,322	303.9	76,277	75,954	55,041	55,131	69,371	69,532	55,485	56,244
North America	**276,215**	**654**	**249**	**93,477**	**84,352**	**296.2**	**82,414**	**81,811**	**70,622**	**70,659**	**85,988**	**86,076**	**79,286**	**79,945**
ASIA														
Afghanistan	15,445	0	0	0	0	0.2	3	3	0	0	0	0	0	0
Bahrain	451	0	0	0	0	13.3	6	6	0	0	0	0	0	0
Bangladesh	112,428	9	9	165	126	1.3	137	150	113	116	129	132	88	96
Bhutan	1,481	0	0	0	0	0.7	1	1	0	0	0	0	0	0
Brunei	270	0	0	0	0	11.1	3	3	0	0	0	0	0	0
Burma	40,785	3	2	31	30	1.2	47	47	27	29	27	27	29	29
China, People's Rep	1,111,910	250[1]	176[1]	15,500e	11,000e	12.6	13,229	13,969	9,467	9,767	12,645	13,333	8,686	9,300
Cyprus	695	1	0	10e	0	63.3	43	44	0	0	3	4	0	0
Hong Kong	5,752	3	0	125e	0	155.6	837	895	0	0	17	45	0	0
India	835,240	310	210	3,014	1,450e	2.9	2,229	2,440	1,350	1,350	2,000	2,185	1,050	1,050
Indonesia	178,380	40	17	1,250e	750e	5.0	829	896	658	710	932	1,106	467	510
Iran	54,842	6	2	315	188	7.8	426	426	77	80	142	142	65	65
Iraq	17,300	2	2	144	90	14.0	222	242	50	69	82	102	10	10
Israel	4,518	5	0	190	0	104.5	461	472	67	63	179	178	0	0
Japan	123,260	486	58	28,847	13,475	222.7	25,035	27,444	13,492	14,340	24,624	26,809	10,415	10,987
Jordan	4,086	3	0	18	0	14.9	69	61	4	5	10	12	0	0
Cambodia	8,046	0	0	0	0	0.2	2	2	0	0	0	0	0	0
Korea, People's Rep	22,432	6	2	100e	80e	3.6	80	80	70	70	80	80	60	60
Korea, Rep. of	42,380	150	5	4,674	400	91.2	3,443	3,866	1,218	1,261	3,659	4,018	313	302
Kuwait	2,010	1	0	25e	0	45.3	91	91	10	10	23	23	0	0
Laos	3,960	0	0	0	0	0.3	1	1	0	0	0	0	0	0
Lebanon	2,847	3	0	50e	0	8.8	45	25	5	2,000	15	15	0	0
Macao	315	0	0	0	0	12.7	4	4	0	0	0	0	0	0
Malaysia	16,901	14	1	220e	92e	32.5	547	549	127	147	204	214	100	120
Mongolia	2,150	1	1	10e	6e	9.3	20	20	5	5	5	5	5	5
Nepal	18,469	2	2	10e	8e	1.1	21	21	0	0	7	7	0	0
Oman	1,163	0	0	0	0	5.2	6	6	0	0	0	0	0	0
Pakistan	108,678	28	18	280	100	3.7	331	400	86	104	144	161	45	57
Philippines	61,043	27	3	564	201	9.8	533	596	125	313	341	382	113	267
Qatar	369	0	0	0	0	27.1	10	10	0	0	0	0	0	0
Saudi Arabia	13,614	0	0	0	0	8.1	100	110	0	0	0	0	0	0
Singapore	2,674	2	0	31	0	89.8	250	240	6	6	10	10	0	0
Sri Lanka	17,009	2	2	27	26	5.7	97	97	15	15	27	27	6	6
Syria	12,073	15	15	7e	0	6.4	80	77	5	0	5	7	5	0
Taiwan	20,127	155	4	3,650e	500e	157.8	3,045	3,176	846	842	2,949	3,042	425	437
Thailand	55,044	33	5	900e	150e	18.3	825	1,005	230	270	610	690	170	190
Turkey	54,698	35	14	1,000e	726e	17.4	618	951	492	565	715	785	352	450
Utd Arab Emirates	1,600	0	0	0	0	46.9	75	75	0	0	0	0	0	0
Vietnam	65,820	30	1	120e	60e	1.0	66	66	40	40	60	60	30	30
Yemen Arab Rep.	7,773	0	0	0	0	0.3	2	2	0	0	0	0	0	0
Yemen Dem. Rep.	2,411	0	0	0	0	0.8	2	2	0	0	0	0	0	0
Asia	**3,050,449**	**1,622**	**549**	**61,277**	**29,458**	**19.2**	**54,071**	**58,571**	**28,585**	**32,177**	**49,644**	**53,601**	**22,434**	**23,971**

Notes: Some figures are estimates.

1: Peo. Rep. China has approximately 5,000 paper mills and 9,000 pulp mills. Only the 250 largest are included here.

Country	Population (1,000)	Number of mills		Capacity (1,000 tons)		Per capita (kg)	Apparent consumption (1,000 tons)				Production (1,000 tons)			
							P&B		Pulp		P&B		Pulp	
		P&B	Pulp	P&B	Pulp		1988	1989	1988	1989	1988	1989	1988	1989
LATIN AMERICA														
Argentina	31,914	100	25	1,300	880	26.6	939	850	686	685	963	917	729	722
Bahamas	257	0	0	0	0	58.4	15	15	0	0	0	0	0	0
Barbados	258	0	0	0	0	27.1	7	7	0	0	0	0	0	0
Belize	178	0	0	0	0	16.9	3	3	0	0	0	0	0	0
Bolivia	7,067	1	0	2e	0	3.0	21	21	0	0	1	1	0	0
Brazil	147,850	146	38	5,457	4,913	28.1	3,870	4,156	3,286	3,582	4,684	4,831	4,292	4,501
Chile	12,938	8	7	455	924	27.8	361	360	431	359	450	445	910	841
Colombia	31,190	24	5	581	283	18.4	587	574	290	286	504	503	247	256
Costa Rica	2,940	1	1	18	7	41.5	120	122	7	9	12	18	6	7
Cuba	10,248	9	3	175e	60e	32.2	321	330	110	110	150	150	55	55
Dominican Rep.	7,038	2	0	15e	0	9.2	65	65	4	4	9	9	0	0
Ecuador	10,477	5	2	65	35	9.3	97	97	17	17	67	67	6	6
El Salvador	5,149	3	0	50e	0	13.0	67	67	12	12	29	29	0	0
Guatemala	8,883	4	0	60	0	9.7	86	86	9	9	40	40	0	0
Guyana	1,006	0	0	0	0	7.0	7	7	0	0	0	0	0	0
Haiti	6,369	0	0	0	0	0.9	6	6	0	0	0	0	0	0
Honduras	4,980	0	0	0	0	6.0	29	30	0	0	0	0	0	0
Jamaica	2,473	1	0	15	0	17.4	43	43	1	1	13	13	0	0
Mexico	86,573	67	15	3,422	1,104	31.3	2,484	2,709	1,102	1,095	2,593	2,737	798	799
Neth. Antilles	188	0	0	0	0	16.0	3	3	0	0	0	0	0	0
Nicaragua	3,723	0	0	0	0	2.1	8	8	0	0	0	0	0	0
Panama	2,371	3	0	30e	0	35.0	83	83	1	1	28	28	0	0
Paraguay	3,700	3	0	15e	2e	11.1	32	41	1	1	8	8	1	1
Peru	21,785	17	3	405	270	7.3	351	158	151	70	260	110	92	53
Puerto Rico	3,309	0	0	0	0	57.1	232	189	313	40	0	0	0	0
Surinam	398	0	0	0	0	10.1	4	4	0	0	0	0	0	0
Trinidad/Tobago	1,271	0	0	0	0	26.8	33	34	2	2	0	0	0	0
Uruguay	3,094	5	2	83	27	22.3	69	69	33	33	66	66	26	26
Venezuela	19,236	12	3	785	184	32.9	922	632	372	223	708	525	103	88
Latin America	**436,863**	**411**	**104**	**12,933**	**8,689**	**24.7**	**10,865**	**10,769**	**6,828**	**6,539**	**10,585**	**10,497**	**7,265**	**7,355**
AUSTRALASIA														
Australia	16,549	0	19	2,395e	1,295e	171.9	2,544	2,844	1,251	1,263	1,854	1,954	1,051	1,061
Fiji	715	0	0	0	0	16.8	13	12	0	0	0	0	0	0
New Zealand	3,386	6	7	846	1,435	159.2	527	539	653	738	701	735	1,212	1,259
Papua New Gunea	3,893	0	0	0	0	1.5	6	6	0	0	0	0	0	0
Samoa	208	0	0	0	0	14.4	3	3	0	0	0	0	0	0
Australasia	**24,751**	**6**	**26**	**3,241**	**2,730**	**137.5**	**3,093**	**3,404**	**1,904**	**2,001**	**2,555**	**2,689**	**2,263**	**2,320**
AFRICA														
Algeria	24,571	5	3	128	110	10.6	246	260	77	78	76	85	8	8
Angola	9,818	2	1	30e	45e	1.9	19	19	15	15	15	15	15	15
Benin	4,610	0	0	0	0	0.9	4	4	0	0	0	0	0	0
Botswana	1,240	0	0	0	0	0.8	1	1	0	0	0	0	0	0
Burkina Faso	8,749	0	0	0	0	0.2	1	2	0	0	0	0	0	0
Burundi	5,301	0	0	0	0	0.8	4	4	0	0	0	0	0	0
Cameroon	10,959	0	0	0	0	0.9	10	10	0	0	0	0	0	0
Central African Rep	2,841	0	0	0	0	0.4	1	1	0	0	0	0	0	0
Chad	5,552	0	0	0	0	0.2	1	1	0	0	0	0	0	0
Congo	1,952	0	0	0	0	0.5	1	1	0	0	0	0	0	0
Egypt	52,817	16	3	180e	60e	10.7	560	564	100	100	160	164	70	70
Ethiopia	46,096	1	1	15	7	0.5	21	21	8	8	11	11	4	4
Gabon	1,103	0	0	0	0	1.8	2	2	0	0	0	0	0	0
Gambia	833	0	0	0	0	2.4	2	2	0	0	0	0	0	0
Ghana	14,543	0	0	0	0	0.6	9	9	0	0	0	0	0	0
Guinea	6,705	0	0	0	0	0.6	4	4	0	0	0	0	0	0
Ivory Coast	12,054	0	0	0	0	6.6	80	80	0	0	0	0	0	0
Kenya	27,200	6	1	130	71	4.7	124	128	67	66	101	108	64	65
Lesotho	1,721	0	0	0	0	0.6	1	1	0	0	0	0	0	0
Liberia	2,474	0	0	0	0	0.4	1	1	0	0	0	0	0	0
Libya	4,362	10	0	10e	0	3.2	14	14	6	6	6	6	0	0
Madagascar	11,594	2	2	28	6	0.8	8	9	7	9	8	9	4	5
Malawi	8,139	0	0	0	0	1.8	12	15	0	0	0	0	0	0
Mali	9,078	0	0	0	0	0.1	1	1	0	0	0	0	0	0
Mauritania	1,973	0	0	0	0	2.0	4	4	0	0	0	0	0	0
Mauritius	1,097	0	0	0	0	5.5	6	6	0	0	0	0	0	0
Morocco	24,505	7	1	126	100	10.9	251	267	18	55	115	120	108	107
Mozambique	15,265	2	0	10e	0	1.1	17	17	1	1	2	2	0	0
Namibia	1,825	0	0	0	0	1.1	2	2	0	0	0	0	0	0
Niger	6,901	0	0	0	0	0.4	3	3	0	0	0	0	0	0
Nigeria	108,635	3	3	230	200	2.9	295	320	52	95	50	70	40	35
Rwanda	7,003	0	0	0	0	0.7	5	5	0	0	0	0	0	0
Senegal	7,191	0	0	0	0	0.6	4	4	0	0	0	0	0	0
Sierra Leone	4,045	0	0	0	0	0.2	1	1	0	0	0	0	0	0
Somalia	7,332	0	0	0	0	0.3	2	2	0	0	0	0	0	0
South Africa	34,489	19	9	2,100	2,256	44.9	1,518	1,547	1,269	1,310	1,870	1,899	1,799	1,840
Sudan	21.500	2	0	4	0	1.3	29	27	0	0	10	5	0	0
Swaziland	758	1	1	5	180	6.6	5	5	5	-8	3	3	178	147
Tanzania	26,250	2	4	70	76	0.6	16	16	35	35	30	30	35	35
Togo	3,355	0	0	0	0	0.1	0	0	0	0	0	0	0	0
Tunisia	7,987	5	1	50e	25	12.5	97	100	30	30	37	40	20	20
Uganda	17,765	1	0	5e	0	0.4	7	7	2	2	2	2	0	0
Zaire	34,741	1	0	4e	0	0.3	11	11	2	2	3	3	0	0
Zambia	8,134	1	0	13	0	1.7	14	14	1	1	4	4	0	0
Zimbabwe	9,466	3	2	90	42	10.0	94	95	62	64	85	85	40	42
Africa	**624,529**	**89**	**32**	**3,228**	**3,178**	**5.8**	**3,508**	**3,607**	**1,757**	**1,869**	**2,588**	**2,661**	**2,385**	**2,393**
TOTAL WORLD	**5,197,214**	**4,390**	**1,393**	**257,894**	**180,719**	**44.6**	**225,017**	**231,550**	**160,574**	**165,332**	**226,905**	**233,170**	**160,931**	**163,904**

European pulp production grew 1.3% to a record 47.9 million tons, with western Europe providing 33.4 million tons. Pulp consumption in Europe also set a new record at 52.1 million tons.

The European Community's top paper and board producer, West Germany, also ranks as the fifth largest-producing nation worldwide. The nations' paper and board output increased in 1989 by 4%, to 11.3 million tons.

Some 11% of the industry's total turnover, or almost DM 2,000 million ($1,200 million), was invested in new and existing installations last year, with more than one-tenth of that amount spent on environmental protection. Current plans foresee an increase in paper and board capacity of 2.4 million tpy to 14.4 million tpy. That should help satisfy what may eventually be soaring demand for paper and board from the Eastern bloc's 400 million inhabitants. In view of the problems confronting the Eastern bloc, however, that is a prospect for the medium to long term.

Paper and board consumption in France rose by 5.3% to 8.4 million tons, following on from the 9.2% recorded in 1988. The rate of growth has outstripped that of the general economy since 1986. Output of paper and board rose by 7% to 6.75 million tons.

Consumption in Italy rose 5% higher than GDP, which grew at a rate of 2.3% in 1989. The country's 301 companies, with 335 mills, are now producing a record 5.6 million tpy of paper and board, up 1.6% from 1988 figures. Production was expected to remain stable or rise by around 2% in 1990.

The U.K.'s output bumped up 4.2% to 4.5 million tons in 1989. And some significant capacity additions are on the drawing board, including the North British Newsprint mill (now being led by Abitibi-Price Inc. of Canada), another waste-based newsprint paper machine at Reedpack's Aylesford mill, and British Sugar's bleached straw pulp mill. Tait Paper at Inverurie, Scotland, is to add a further 50,000 tpy of uncoated woodfree paper capacity by 1992.

In addition, foreign acquisitions accelerated, motivated by the approach of 1992 or the opening of the Channel Tunnel. Most significant was the purchase of Reedpack by Sweden's SCA. DRG, the former John Dickinson mills, was acquired by Bermuda-based Pembridge Investments. Its three paper mills were sold to South Africa's Sappi, allowing Pembridge to concentrate on DRG's packaging operations. DRG Carton was also divested, sold to U.S.-based Manville Corp. Meanwhile New Zealand's Fletcher Challenge bought UK Paper Ltd., formerly the U.K. side of Bowater, only three years after its management buyout. And Wiggins Teape Appleton was demerged from B.A.T Industries in June, which could result in changes in ownership.

The European paper industry as a whole has been busily reorganizing as the EC Single Market approaches in 1992. In late April 1990, Sweden's Stora purchased the major West German papermaker Feldmühle, an acquisition that marked Sweden's continued interest in moving into the EC. It also vaulted Stora into fourth position among the world's largest forest products companies. Then in June, SCA bought Reedpack, the U.K. office supplies, paper, and packaging group.

Between 1985 and 1989, Swedish forest companies invested more than Skr11,000 million with the EC, compared with Skr1,400 million between 1981 and 1984. In 1989, investment in EC countries totaled about Skr5,200 million. And in 1990, excluding the Reedpack purchase, the figure was expected to exceed more than Skr20,000 million.

Swedish production of paper and board in 1989 totalled 8.4 million tons, an increase of 3% on 1989.

Finland also joined in the merger and acquisition game. Metsä-Serla bought a 30% stake in United Paper Mills in an unexpected move. UPM reacted by forming an alliance with Rauma-Repola Oy, leading to the merger of the two companies to form a new group called Repola Oy. Elsewhere, Enso-Gutzeit Oy took control of fine paper producer Berghuizer in the Netherlands, and Myllykoski bought the West German papermaking operations of the Holzstoff group of Switzerland. Nokia allied its tissue making business with Ferruzzi and James River Corp.

Pulp was the most profitable sector of Finland's forest industry in 1989, with some producers achieving operating margins of over 40%. But high pulp prices reduced paper mill profits, and weakening demand in the mechanical papers sector forced producers to take some downtime.

Major organizational changes also took place in Norway during 1989. Norske Skogindustrier, Follum Fabrikker, and Tofte Industrier were merged under the name of Norske Skogindustrier. Later the company additionally took over Saugbrugsforeningen.

Paper and board production in the country set a new record for the second consecutive year, rising by 120,000 tons, or just over 7%.

Activity in the forest industries continued to grow during 1989, and supplies of pulpwood expanded by about 5%.

Expansion is also due in Eastern Europe. The Soviet Union—the world's sixth largest paper producing nation—is set for a papermaking boom over the next ten years or so. The Soviet ministry with responsibility for the industry has set itself the target of doubling per-capita paper and board consumption in the medium term. Currently it is a mere 79 lb/capita, well below the world average.

There has been considerable foreign interest in investment in the Soviet Union, but apart from Metsä-Serla's new Est-Serla tissue mill in Tallinn, Estonia, no paper industry joint ventures have been announced within the borders of the U.S.S.R. However, discussions are under way.

Among the discussions taking place, Finland's Enso-Gutzeit is still expressing an interest in building a major new newsprint paper machine near Läskelä in Soviet Karelia. The deal would probably hinge on the availability of cheap, stable electricity prices and competitive fiber rates. Meanwhile, Enso's joint venture at Uimaharju in Finnish Karelia is proceeding well, with the digester line for the new mill now ordered. Canada's Abitibi-Price is believed to be considering a newsprint machine at the Kondopoga mill, renowned as one of the most efficient in the U.S.S.R. Recently, the giant Bratsk mill announced it was seeking partners in order to expand. Some investment, funded by the Soviet Ministry, is already proceeding. Notably, the Syktyvkar mill is adding a new board machine from Voith at its printing paper and liquid packaging board mill in Komi Republic.

Productivity in Eastern Europe is a problem that venture partners will have to face. Average productivity in the East German pulp and paper industry, for example, is only 30% and consumption just 40% of West Germany's total. Machines are old and pollution levels are high compared with Western standards. Substantial investment is needed to raise productivity and quality if the industry is to become competitive.

State control of pulp and paper mills in East Germany was sustained during the first three quarters of 1989. Some older production lines that had not been upgraded ran at a low capacity. However, in the fourth quarter, pulp and paper production declined. This was mainly due to a reduced supply of spruce from the U.S.S.R., coupled with the migration of workers to West Germany, which made it impossible for some mills to maintain a seven-day working week.

Further changes now lie ahead as the country moves toward a free market economy and monetary union with West Germany. For the pulp and paper industry, the consequences will be significant. Free market competition and stricter environmental regulations will force some older, less productive mills to shut down. Others will have to respond to the demand for higher-quality goods with the introduction of new grades.

LATIN AMERICA

In Latin America, paper and board output drifted down by 0.8% in 1989 to 10.5 million tons. The industry was suffering under the impact of severe economic measures imposed to quash uncontrolled inflation.

In Brazil, for example, inflation rates of 2,000%/year marked the end of the first term of civilian government for 15 years. Direct elections were held for the post of President of the Republic and resulted in victory for a new government, headed by President Collor de Mello, who took office in March 1990. The new government immediately introduced tough measures to bring inflation under control. The result was a severe slowing down of economic activity on the domestic market. Recovery from the recessive economic conditions was not expected before the end of 1990.

Faced with a curtailment of domestic demand for its products, Brazil's paper industry is making a strong effort to increase its sales abroad. The target is to double exports, in spite of low prices in some export markets. The process may have been assisted by the removal in mid-1990 of U.S. bans on imports of Brazilian printing and writing papers.

In the pulp sector, output of bleached eucalyptus kraft was forecast to rise by 155% from 1989 levels, to reach 3.4 million tons in 1993. Capacity for the pulp is increasing. Aracruz was to complete a project to double capacity of bleached eucalyptus pulp in November 1990, creating the

TOTAL WORLD PAPER/BOARD CONSUMPTION AND PRODUCTION PROJECTIONS TO 1995

(million metric tons)

FAO regions and subregions	Consumption					Production				
	Actual	FAO		Chase		Actual	FAO		Chase	
	1984	1990	1995	1990	1995	1984	1990	1995	1990	1995
Developed market economies	144.4	156.1	177.1	155.9	172.7	150.2	169.5	196.4	168.8	190.6
North America	73.4	76.1	82.6	78.3	84.6	76.5	83.5	93.2	87.7	97.0
West Europe	46.7	50.6	58.9	50.4	56.8	49.9	56.3	66.1	54.0	62.0
Oceania	2.5	2.8	3.2	2.9	3.3	2.2	2.4	2.9	2.3	2.6
Others	21.6	26.5	32.2	24.2	27.9	21.4	27.2	34.0	24.6	28.8
Developing market economies	20.1	27.9	37.0	26.5	34.7	15.3	17.2	22.1	16.5	21.3
Africa	0.8	1.1	1.4	1.1	1.3	0.3	0.4	0.5	0.4	0.5
Latin America	9.7	13.3	17.0	11.9	15.2	8.6	10.0	12.5	7.9	10.1
Near East Africa	0.4	0.7	0.9	0.6	0.7	0.1	0.1	0.1	0.1	0.2
Near East Asia	1.3	1.7	2.2	1.6	2.1	0.6	0.7	1.0	0.8	1.0
Far East	7.7	10.9	15.2	11.1	15.2	5.5	5.8	7.8	7.1	9.4
Centrally planned economies	22.8	31.8	40.6	31.5	38.5	22.0	29.1	36.2	28.6	33.8
Asia	7.5	12.1	16.2	14.5	20.0	7.0	10.5	13.7	12.3	16.2
Europe, U.S.S.R.	15.2	19.7	24.4	16.9	18.4	15.0	18.5	22.5	16.3	17.6
World	187.3	215.9	254.8	214.0	245.9	187.6	215.9	254.8	214.0	245.9

Source: United Nations Food & Agriculture Organization's Outlook Study.

WORLD PAPER AND BOARD CAPACITY

(000 metric tpy)

	Capacity		Average annual increase (%)	
	1989	1994	1984-89	1989-94
World total	250,991	288,805	3.4%	2.8%
Developed market economies	192,568	223,446	3.1	3.0
North America	93,240	104,984	2.4	2.4
Japan	28,847	35,604	4.2	4.3
Western Europe	65,601	77,893	3.7	3.5
Oceania	2,814	2,879	-0.6	0.5
Others	2,066	2,086	3.1	0.2
Developing markets	26,100	31,695	5.4	4.0
Africa	1,208	1,521	5.1	4.7
Latin America	13,055	16,201	3.2	4.4
Asia	11,837	13,973	8.2	3.4
Centrally planned economies	32,323	33,664	4.0	0.8
Asia	13,623	13,623	17.7	0.0
Eastern Europe	6,850	7,241	0.9	1.1
U.S.S.R.	11,850	12,800	-3.3	1.6

Source: United Nations Food & Agriculture Organization.

1989 PAPER, BOARD, AND PULP PRODUCTION IN WESTERN EUROPE

(000 metric tons)

Country	Paper and board production	% change 1989/88	Pulp Production	% change 1989/88
Austria	2,754	3.9	1,365	3.4
Belgium	1,145	0.8	462	3.1
Denmark	328	(4.4)	105	10.5
Finland	8,749	1.1	8,955	1.2
France	6,753	7.0	2,274	4.2
Fed. Rep. Germany	11,261	4.0	2,280	2.8
Ireland	33	(2.9)	0	
Italy	5,556	0.8	776	(1.6)
Netherlands	2,573	4.5	167	(9.2)
Norway	1,789	7.1	2,020	7.7
Portugal	735	7.9	1,482	0.7
Spain	3,447	1.1	1,576	3.3
Sweden	8,363	2.7	10,338	0.6
Switzerland	1,259	3.5	328	(2.1)
U.K.	4,475	4.2	446	(0.9)
Total	59,220	3.3	32,574	1.7

Source: European Paper Institute.

world's first 1-million-tpy market pulp mill. Cenibra also decided to go ahead with a doubling of its capacity to 700,000 tpy. Startup will be in early 1993. Simao will add 190,000 tpy of eucalyptus grades by mid-1992, doubling capacity. Latin America's biggest producer, Klabin, is also doubling output at its Riocell mill to 700,000 tpy. And the company has plans for another big mill—the Norcell project—in the mid-1990s. Finally, Champion gave the okay for its new 600-tpd Mato Grosso mill.

Among paper projects, Inpacel is going ahead with its integrated chemi-thermomechanical-pulp-based printing/writing mill. Bahia Sul, a joint venture between Suzano de Papel e Celulose and Companhia Vale Rio Doce (CVRD), will add 250,000 tpy to Brazilian printing/writing output, and Votorantim's Celpav project is forging ahead, adding 800 tpd of new capacity on two Voith paper machines.

In Chile, 1989 was a profitable year for pulp and paper companies, and investment plans for upgrading existing mills and adding new lines are proceeding. Compania Manufacturera de Papeles y Cartones's (CMPC) biggest investment was the 315,000-tpy Celpac kraft pulp mill project being undertaken with Simpson of the U.S. It will operate on radiata pine. As of mid-1990, major equipment had been bought, financing was settled, and civil works and construction of buildings had begun. Also in the CMPC group, the Puente Alto and Valdivia mills planned to invest $37 million to increase production of recycled papers and improve the quality of their paper and cartonboard grades.

WORLD PAPER-GRADE WOODPULP CAPACITY

(000 metric tpy)

	Capacity		Average annual increase (%)	
	1989	1994	1984-89	1989-94
World total	163,972	187,452	2.1%	2.7%
Developed market economies	135,221	152,075	2.2	2.4
North America	82,618	91,715	2.2	2.1
Japan	13,146	15,646	1.7	3.5
Western Europe	35,313	40,432	2.4	2.7
Oceania	2,694	2,832	0.5	1.0
Others	1,450	1,450	7.2	0.0
Developing markets	11,034	17,362	4.8	9.5
Africa	952	1,116	6.6	3.2
Latin America	7,556	13,071	4.4	11.6
Asia	2,526	3,175	5.4	4.7
Centrally planned economies	17,717	18,015	0.1	0.3
Asia	1,938	1,938	10.0	0.0
Eastern Europe	4,394	4,442	-0.1	0.2
U.S.S.R.	11,385	11,635	-1.1	0.4

Source: United Nations Food & Agriculture Organization.

Celarauco and Stora Kopparberg of Sweden formed a joint venture in Chile, in which Stora invested $82.5 million. As a result of this joint venture, the companies own half each of Forestal Pedro de Valdivia. In the next few years, a decision will be taken on whether to build a new 450,000-to-500,000-tpy kraft pulp mill. Finally, the Santa Fé project to build a 250,000-tpy eucalyptus pulp mill near Nacimiento was well under way.

In Venezuela, new austerity policies were implemented in February 1989 and were, in part, responsible for serious civil disturbances. Price controls were removed except for a basket of essential items, including certain products of the paper and board industry.

New tariff reductions established maximum duty protection of 50% for consumer items, 30% for capital goods, 40% for intermediates, and 10% on imports of raw materials. The previous duties were reduced substantially, and further sharp reduction has become effective since then.

The paper and board industry was seriously affected in 1989 by the austerity measures, and sales of all products were reduced sharply. As a consequence, only those companies that exported a significant portion of their output were able to maintain normal production levels.

Wide-ranging reforms were begun in Argentina, but the major adjustment was in increased taxes. Industrial output was severely curtailed. In this context, income levels already eroded by inflation were further depressed, and, consequently, the paper market remained weak throughout 1989. Pulp, paper, and converted products exports topped $150 million during the year, an increase of 50% over the previous year. and reflected the general industrial trend. On a long-term basis, with 4,900% inflation affecting the cash flow of all firms, major investments have proceeded at a slow pace.

Production of paper and board in Mexico rose 5.5% over 1988. Apparent consumption jumped 9% vs 3.7% the previous year, driving up per capita consumption for the first time in four years. Production of board and printing and writing papers led with 15.5% and 7.2% growth in output respectively. Case-making materials and especially coated folding boxboard were in strong demand as the Mexican economy improved and exports of packaged manufactured goods continued to grow.

FAO CAPACITY SURVEY

In its *Pulp and Paper Capacities Survey: 1989-1994*, the Food & Agriculture Organization of the United Nations estimated that world capacity for paper and paperboard would increase at an average annual rate of 2.8% to 288.8 million metric tons by 1994. That compares with a 3.4% annual expansion over 1984-89. These moderate rates mask considerable changes in year-to-year capacity expansions. In 1989-91, growth will be above 4%/year, but it will have sunk to less than 1% by 1994.

In 1989, world capacity was 251.0 million tons, with about 77% of that in developed countries. That percentage will not change much by 1994. Newsprint capacity will increase at an average annual rate of 3.2% to 40.7 million tons by 1994. About 83% of that capacity will be in the developed world. Printing/writing papers capacity will rise 3.9%/year during the period to 86.0 million tons. Again, over 80% of this capacity is in developed markets. Growth for this grade will actually slow from the 5.4%/year rate of 1984-89.

Total world capacity for paper-grade woodpulp will rise 2.7%/year to 187.5 million tons by 1994. That compares with a 2.1%/year increase during 1984-89. Capacity in 1989 was 164.0 million tons. The grade breakdown for 1994 will be as follows: mechanical, 48.1 million metric tons; semichemical, 9.9; chemical, 128.6; other fiber pulp, 15.6; and dissolving pulp, 5.4. Mechanical pulp will have the strongest growth rate during 1989-94 at 2.9%/year. Chemical pulp capacity will grow 2.8%/year.

GLOSSARY OF INDUSTRY TERMS

Reprinted from *Pulp & Paper Dictionary* by John R. Lavigne (Miller Freeman Publications, 1986).

A

ABRASION RESISTANCE. Ability of a paper product to withstand abrasion. Measured by determining degree and rate that a sample loses weight under specific rubbing action of an abrading substance, such as an eraser.

ABSORBENCY. Property of pulp, paper, and its constituents and products that permits the entrainment and retention of other materials it contacts, such as liquid, gaseous, and solid substances.

AIR DRY (a.d.). Weight of moisture-free pulp or paper plus 10% moisture based on traditional assumption that this amount of moisture exists when they come into equilibrium with the atmosphere.

ALUM. Papermaking chemical commonly used for precipitating rosin size onto pulp fibers to impart water-resistant properties (when used for water treatment) to the paper. Also called *aluminum sulfate*.

ANTITARNISH PAPER. Term originally applied to higher-weight tissues used for wrapping silverware, but now used for all papers so prepared that they will not rust or discolor razor blades, needles, silverware, etc.

APPARENT DENSITY. Weight (mass) per unit volume of a sheet of paper obtained by dividing the basis weight by the caliper (thickness).

B

BASESTOCK. Paper or board to be further treated in various ways.

BASIS WEIGHT. Weight in pounds of a ream of paper, usually consisting of 480, 500, or 1,000 sheets of a specified size.

BEATER. Large, longitudinally partitioned, oval tub used to mix and mechanically "work" pulp with other ingredients to make paper.

BEATING. See *refining*.

BINDERS BOARD. Gray-colored, glazed board often used in the binding of hardcover books.

BIOLOGICAL OXYGEN DEMAND (BOD). Amount of dissolved oxygen consumed in five days by biological processes breaking down organic matter in mill effluent.

BISULFITE PULP. Pulp made by the bisulfite cooking process using bisulfite cooking liquor.

BOGUS. Product that has been made from wastepaper or other inferior materials to imitate higher-quality grades.

BOND. Class of printing/writing papers made from bleached chemical woodpulps and cotton fibers.

BONDING STRENGTH. Intralayer binding force in a multi-ply paperboard or laminate. Also refers to the degree of adherence of coating and film on a sheet and to the interfiber binding force within a sheet.

BONE DRY (b.d.). (1) Descriptive term for the moisture-free conditions of pulp paper. See *oven dry*. (2) Refers to air containing no vapor.

BOOK PAPER. Paper suitable for printing and other uses in the graphic arts industry.

BRIGHTNESS. Measure of the degree of reflectivity of a sheet of pulp or paper for blue light measured under specified standard conditions. Also called *whiteness*.

BRISTOLS. Heavy-grade papers possessing higher-than-average quality characteristics. Rigid enough to be used for announcements, invitations, postcards, etc.

BROKE. Paper trimmings or damaged paper due to breaks on paper machine and in finishing operations.

BULK. Compactness property of a sheet in relation to its weight (whose value decreases as compactness increases).

BURSTING STRENGTH. Resistance of paper to rupture when pressure is applied to a side by a specified instrument. Also called *burst*, *mullen*, and *pop strength*.

C

CALENDER. Piece of processing equipment located at dry end of paper machine, consisting of a set of rolls through which paper sheet is passed for smoothing, leveling, and gloss improvement.

CALENDER FINISHED. Paper and paperboard passed through a calender to improve surface characteristics by application of pressure, friction, or moisture.

CALIPER. Thickness of a sheet of paper or paperboard, measured under certain specifically stated conditions, expressed in units of thousandths of an inch (called "mils" when referring to paper, "points" when referring to paperboard). Also called *thickness*.

CARBONIZING PAPER. Lightweight, uncoated paper made from unbleached chemical and/or mechanical pulps and surface-coated with a carbon solvent or wax so that it takes up carbon inks and releases them under pressure, thereby duplicating the inked areas being printed.

CARBONLESS PAPER. Copying paper that is treated or coated so it can be used without needing carbon coating or interleaved carbon paper.

CARLOAD. Quantity of paper shipped from mill in one freight car. Must exceed a freight classification zone minimum weight to qualify for carload freight rate.

CAST-COATED PAPER. Very high-gloss coated paper and paperboard with surface characteristics produced by allowing applied coating to harden while in contact with surface of steam-heated, highly polished, chrome-plated drum.

CELLULOSE. Chief substance in cell walls of plants used to manufacture pulp.

CELLULOSE WADDING. See *wadding*.

CHEMICAL PULP. Mass of fibers resulting from reduction of wood or other fibrous raw material into component parts during cooking phases with various chemical liquors in processes such as sulfate, sulfite, soda, and NSCC.

CHEMI-THERMOMECHANICAL PULP (CTMP). Pulp made by thermomechanical process in which woodchips are pretreated with a chemical, usually sodium sulfite, either prior to or during presteaming as an aid to subsequent mechanical processing in refiners.

CHIPBOARD. Inferior-quality, low-density, solid or lined paperboard made primarily from recycled wastepaper stock and used in low-strength applications.

CLARIFIERS. Storage tanks in which suspended solids are allowed to settle and be removed from green and white liquors in the causticizing areas of a pulp mill.

COATED. Papers and paperboards that contain a layer of coating material, such as clay or pigment, in combination with an adhesive.

COMBINATION BOARD. Multi-layered, cylinder-made paperboard having outer and inner layers made from different pulpstocks.

COMBINED BOARD. Multi-layered board made by uniting a number of boards with proper adhesives.

CONSTRUCTION PAPER. Heavy type of paper used for watercolor and crayon artwork, made in various colors primarily from groundwood pulp.

CONTAINERBOARD. Single- and multi-ply, solid, and corrugated boards used to make boxes and other containers for shipping materials.

COOK. Process of reacting fiber-containing materials, such as wood, rag, straw, and bagasse, with suitable chemicals, usually under high temperature and pressure, in order to reduce them into component parts so that acceptable fibers can be separated and made into pulp.

CORD. Pulpwood volume measurement indicating a pile measuring 4 ft x 4 ft x 8 ft, equaling 128 ft^3 (3.62 m^3).

CORRUGATED BOARD. (1) A pasted, single- or double-faced, multilayered board having a fluted bottom or middle layer. (2) The fluted paperboard after it has gone through the corrugating operation and before it is pasted to the flat facing board sheet.

CORRUGATING MEDIUM. Paperboard made from chemical and semichemical pulps, sometimes mixed with straw or recycled paperstock, that is to be converted to a corrugated board by passing it through a corrugating machine.

COVER PAPER. Paper used as a protective covering for books, pamphlets, magazines, catalogs, and boxes.

CREPE PAPER. Low-basis-weight paper made from sulfite, sulfate, or mechanical pulp and given a simulated crinkly finish by crowding the web sheet over a roll with a doctor blade.

CROSS DIRECTION (CD). Side-to-side direction of a paper machine or the paper sheet made on it, as opposed to *machine direction*, which runs from head to exit end.

CUNIT. Pulpwood measurement equivalent to a volume containing 100 ft^3 solid of unpeeled wood.

CURL. Paper or paperboard deformation caused by nonuniform distribution of strains and stresses throughout the sheet as a result of uneven internal moisture and conditioning.

CUT SIZE. Fine paper cut to specific end-use dimensions (16 in. x 21 in. or less) on a paper trimmer usually of the guillotine or rotary type.

CYLINDER MACHINE. Machine primarily used to make paperboards. The forming cylinders are covered with wire so that, as they turn within a vat filled with stock solution, fibers are picked up to form a web on the surface with water draining through and passing out at the ends. The wet sheet is then transferred off the cylinder onto a felt for possible combining with other sheets (multiple cylinders on same machine) and subsequent pressing and drying.

D

DEINKING. Removal of ink and other undesirable materials from wastepaper by mechanical disintegration, chemical treatment, washing, and bleaching before reusing as a source of papermaking fiber.

DIE CUT. Paper and paperboard products cut by a metallic die to specified dimensions or form.

DIGESTER. Pressure vessel used to chemically treat chips and other cellulosic fibrous materials such as straw, bagasse, rags, etc., under elevated temperature and pressure in order to separate fibers and produce pulp.

DIMENSIONAL STABILITY. Ability of a sheet to maintain its original machine and cross-machine dimensions with time and under variable moisture and relative-humidity conditions.

DRY END. Portion of a paper machine where sheet moisture is removed by evaporation. Consists of several dryer sections or air dryers, depending on type and size of the machine.

DRYERS. Portion of a paper machine where water is removed from wet paper by passing it over rotating, steam-heated, cylindrical, metal drums or by running it through a hot air stream.

DUPLEX. (1) Papers and paperboards with each side having a different color, finish, or surface texture, which is produced on the paper machine or by pasting. (2) General term referring to multi-ply paper and paperboard and to bags made of two separate sheets of paper.

E

ELECTROSTATIC COPY PAPER. Smooth-finished, stable, medium-weight bond paper made from chemical pulps. Generally treated with a zinc oxide coating material and used on dry-type office copying machines.

ELMENDORF TEST. Test commonly used in paper mill laboratories to determine tear-resistant property of paper. Also called *tear test*.

ELONGATION. Physical property of a paper sheet that allows it to experience a certain degree of stretching.

EMBOSSED. Paper finish obtained by mechanically impressing a design on the sheet with engraved metallic rolls or plates.

ENAMEL. Clay coating on coated paper.

ENGLISH FINISH. Medium finish applied to a sheet of paper that is smoother than the finish coming off dryers or calenders, but not as smooth as the finish coming off supercalenders.

F

FABRIC PRESS. Paper machine wet press that uses a special multiple-weave fabric belt sandwiched between the regular felt and the rubber-covered roll, increasing the capacity to receive and remove water from the nip between rolls.

FEEL. Evaluation of paper surface finish by sense of touch.

FELT. Woven belt of wool, cotton, or synthetic fibers used to transport sheet of paper between rolls of press section (wet felt) and against dryer drum (dryer felt) in dry-end section of paper machine.

FELT SIDE. Top side of paper sheet as it is formed on wire of wet end of paper machine, which later comes in contact with felts during subsequent drying phases.

FIBER. Elongated, tapering, thick-walled cellular unit that is the structural component of woody plants.

FILLER. (1) Substance added to pulpstock to fill spaces between fibers and enhance printing properties of paper made from it. (2) Inner layers of multi-ply paperboards.

FINE PAPERS. High-quality printing/writing and cover papers having excellent surface characteristics for pen and ink writing.

FINISH. Surface characteristics of sheet of paper, such as smoothness, appearance, and gloss, as determined visually.

FINISHING. Processing of paper after completion of papermaking operations, including supercalendering, slitting, rewinding, trimming, sorting, counting, and packaging prior to shipment from mill.

FLEXOGRAPHIC PRINTING. Rotary letterpress printing process using ink made of aniline dyes and pigments (mixed with a binder) that dries primarily by evaporation due to the solvent vehicle (with rapid evaporation properties) used. Also called *aniline printing*.

FLUFF PULP. Thick sheet or batt of woodpulp fibers manufactured in roll or bale form and suitable for dry disintegration into individual fibers.

FLUORESCENT PAPER. White paper made with synthetic dyes that produce a brighter appearance by increasing the ability to reflect light, or paper that is surface-coated with colored, light-emitting dyestuff materials (which reflect white light as a color).

FORMATION. Physical distribution and orientation of fibers and other solid constituents in the structure of a sheet of paper that affects its appearance and other physical properties.

FOURDRINIER WIRE. Continuously traveling, endless, woven, metallic, or plastic screen belt located in wet-end section of fourdrinier paper machine. Pulpstock is fed onto wire so that water is drained from it as fibers become oriented to form a continuous web.

FREENESS. Ability of pulp and water mixture to release or retain water on drainage.

FREE-SHEET. Sheet of paper containing no mechanical pulp fibers or made of pulp subjected to minimal refining or hydration, which allows water to drain quickly when sheet is formed on fourdrinier wire. Also called *woodfree*.

FURNISH. Various pulps, dyes, additives, and other chemicals blended together in stock preparation area of paper mill and fed to wet end of paper machine to make paper or paperboard. Also called *stock*.

G

GLASSINE. Light, dense, translucent paper made from highly refined chemical pulp and possessing a high degree of hydration. Used as envelope windows and in protective packaging for foodstuffs, candy, tobacco products, chemicals, and metallic items.

GLOSS. Property of paper sheet surface that produces a shiny, highly reflective appearance when light is reflected from it.

GRAIN. Directional alignment of fibers in a paper sheet structure.

GRAVURE PRINTING. Intaglio printing process employing minute engraved "wells." Generally, deeply etched wells carry more ink than a raised surface; hence, they print darker values. Shallow wells are used to print light values. A doctor blade wipes excess ink from the cylindrical printing surface. Rotogravure employs etched cylinders and web-fed stock. Sheet-fed gravure, as its name implies, involves individual sheet feeding.

GROUNDWOOD PAPER. Paper that is made from a furnish containing a large percentage of groundwood pulp.

GROUNDWOOD PULP. Slurry produced by mechanically abrading fibers from barked logs through forced contact with the surface of a revolving grindstone. Used extensively to make newsprint and publication papers.

H-K

HARD-SIZED. Paper and paperboard made resistant to water and ink penetration by exposure to high degree of sizing treatments.

HARDWOOD. Pulpwood from broad-leaved dicotyledonous deciduous trees.

HEMICELLULOSE. Alkali-soluble, noncellulosic polysaccharide portion of a wood cell wall.

HOLDOUT. Ability of paper or board to resist surface liquid penetration.

HOTMELTS. Plastic or wax coating materials in a molten state applied to paper or paperboard sheet to produce fluid-resistant surface with high gloss.

INDUSTRIAL PAPERS. Paper made for purposes such as industrial packaging, tissues, wrappings, impregnating, insulating, etc.

INTEGRATED MILL. Mill manufacturing complex in which all pulp and papermaking operations are conducted at one site.

INTERNAL BONDING STRENGTH. See *bonding strength.*

JOB LOT. Out-of-specification, defective, or discontinued types of paper made in small quantities for special orders and sometimes sold at lower-than-standard prices.

JUMBO ROLL. (1) Larger-than-normal roll of paper as it is slit and rewound. (2) Roll of paper usually greater than 12 in. in diameter and used for converting into user products.

KRAFT PAPER. High-strength paper made from sulfate pulp, usually with a naturally brown color from unbleached pulp. Also called *sulfate paper.*

KRAFT PULP. Fibrous material used in pulp, paper, and paperboard manufacturing, produced by chemically reducing woodchips into their component parts by cooking in a vessel under pressure using an alkaline cooking liquor. Also called *sulfate pulp.*

L

LACQUER. Organic solution with volatile solvents used for coating paper to give high surface gloss, grease resistance, heat sealing, and improved surface appearance.

LAMINATED PAPER. Multi-ply paper and paperboard consisting of firmly united, superposed layers, which may be bonded with resin or adhesive.

LEDGER PAPER. Strong, highly sized paper made from bleached chemical woodpulp. Used to make accounting and record books; also used with accounting machines.

LETTERPRESS PRINTING. Printing process in which ink is applied to paper, paperboard, or film from raised portions of printing plates or type.

LIGNIN. Brown organic substance that acts as an interfiber bond in woody materials.

LINERBOARD. Kraft paperboard, generally unbleached, used to line or face corrugated core board (on both sides) to form shipping boxes and various other containers.

M

MACHINE-COATED. Paper and paperboard that have surface coating of adhesives and minerals applied while being made on the paper machine, as an integral part of the papermaking operation.

MACHINE-DIRECTION (MD). Direction from the wet end to the dry end of a paper machine or to a paper sheet parallel to its forward movement on a paper machine.

MACHINE-FINISH (MF). Surface finish produced on an uncoated sheet of paper as it is being made on the paper machine, and usually accomplished with limited calendering on the machine calender stacks.

MACHINE-GLAZED (MG). High-gloss surface finish produced on the wire side of a sheet by passing it over a large-diameter, highly polished, steam-heated roll as used on yankee-type paper machine dryers.

MANIFOLD PAPER. Very thin regular bond paper with glazed or unglazed finish used to make carbon copies of letters.

MATTE. Paper and surface finishes with very low gloss or luster.

MECHANICAL PULP. Pulp produced by reducing pulpwood logs and chips into their fiber components by the use of mechanical energy, via grinding stones, refiners, etc.

MEDIUM. See *corrugating medium.*

MOISTURE CONTENT (MC). Percent of water by its weight in paper, pulp, paperboard, chips, etc., which will vary according to atmospheric conditions because of the ability of these types of materials to absorb or emit moisture.

MOISTUREPROOF. Ability of paper and paperboard to resist the penetration of water vapor.

MOISTURE VAPOR TRANSMISSION. Ease or rate of water vapor permeation in a sheet of paper.

MOTTLE. (1) Random nonuniformity in printed gloss, or the visual density or color of a printed area caused by uneven absorption of ink by paper. (2) A surface effect produced by the addition of heavily dyed fibers of a different color in the stock furnish.

MULLEN. See *bursting strength.*

MULTI-PLY. Paper or paperboard sheet made up of two or more layers.

N-O

NEWSPRINT. Grade of paper, combining high percentages of groundwood pulp, made especially for use in the printing of newspapers.

NINEPOINT. Paperboards with a thickness of 9 mils (0.009 in.) used as the fluted component in the manufacture of multi-ply combined board or wrapping. See *corrugating medium.*

NONWOVEN FABRIC. Sheet of cloth-like material made from long natural and synthetic fibers and formed from a slurry on a wire screen, such as a wet end of a paper machine, or by laying on a fine mesh screen from an air suspension.

OFF-MACHINE COATING. Process of applying coating material to a sheet of paper or paperboard in a location that is away from the machine on which it is made.

OFFSET PRINTING. Process of indirect printing in which an impression of type or a design on a flat plate is printed on a rubber-blanketed cylinder from which it is impressed ("off-set") upon the surface to be printed.

ONIONSKIN. A thin, lightweight, transparent paper made especially for producing typewritten copies of correspondence.

OPACITY. Ability of substances such as paper, flue gases (smoke), and liquids to resist transmission of both diffuse and nondiffuse light through them. Prevents show-through of dark printing in contact with backside of sheet of paper.

OVEN-DRY (o.d.). Moisture-free conditions of pulp and paper. Usually determined by drying a known sample to a constant weight in a completely dry atmosphere at a temperature of 100°C to 105°C (212°F to 221°F). Also called *bone dry.*

P

PAPER. Homogeneous sheet of felted cellulose fibers, bound together by interweaving and by the use of bonding agents, and made in a variety of types.

PAPERSTOCK. Water slurry of various pulp fibers, dyes, additives, and chemicals that is pumped to the paper machine for forming into a sheet.

PAPETERIE. Chemical pulp and cotton-fiber content paper, made especially for conversion to a class of writing types, usually correspondence stationery.

PATENT COATED. Type of paperboard that is made and lined with white or colored fibers on a multi-cylinder machine, possessing a high surface finish suitable for use in making cartons.

PICK. (1) Phenomenon of pulp or fibers pulling away and sticking to paper machine parts, such as rolls, in the wet and dry end sections. (2) Paper mill control test to determine surface adhesion properties of paper. (3) Small particles of paper that loosen from the surface of paper, especially during printing.

PIGMENT. An insoluble mineral or organic powder used as a dye to color paper and as an additive to impart specific properties—bulk, porosity, opacity—to the sheet.

PLY. Layer that makes up a multi-layered, pasted, or multi-cylinder-formed paperboard.

POINT. Measurement of thickness of a sheet of paper or board (0.001 in.).

POROSITY. Ability of fluids to pass through paper and paperboard, related to size, shape, and distribution orientation of the pores in a sheet and the compactness of the fibers.

PRESSURE-SENSITIVE PAPER. Good-strength paper coated with a pressure-sensitive type of adhesive and converted to tapes and labels.

PRINTABILITY. Ease with which paper can be printed to high-quality standards with the least amount of spoilage.

PULP. Fibrous material produced by mechanically or chemically reducing woody plants into their component parts from which pulp, paper, and paperboard sheets are formed after proper slushing and treatment. Also used for dissolving purposes (dissolving pulp or chemical cellulose) to make rayon, plastics, and other synthetic products. Also called *woodpulp.*

R

RAG CONTENT. Paper containing from 25% to 75% cotton or rag fibers, including bond, ledger, and specialty papers.

REAM. Stack or package of paper containing a number of sheets (usually 480, 500, or 1,000) designated as standard for that grade.

REFINER MECHANICAL PULP (RMP). Pulp made by processing untreated woodchips in mechanical atmospheric refiners.

REFINING. Pulp and paper mill operations conducted of fiber suspensions to rub, brush, crush, fray, or cut fibers as desired. Imparts such characteristics as increased capacity to absorb water and improved sheet formation.

REGISTER PAPER. Lightweight writing grade made from chemical pulp and possessing good tensile and tearing strength. Comes in rolls especially for automatic register machines and in flat, folded, snap-apart packages for computer printouts and other copying purposes.

RELATIVE HUMIDITY. Actual amount of water vapor present in the air as compared with the maximum amount of water vapor the air could hold at that temperature.

RELEASE PAPER. Type of paper made especially for easily removal from sticky surfaces.

ROSIN. Material made up of a suspension and used for internal sizing of paper and paperboard.

ROTOGRAVURE PRINTING. See *gravure printing.*

RUNABILITY. (1) In the paper mill, how well pulp stock furnish to the paper machine forms a sheet on the wire and passes through the drying and finishing operations. (2) Used by customers in reference to how well the paper performs in their converting operations, such as on printing presses.

S

SCREENINGS. Rejected materials, such as knots, shives, and large bark particles, from the screening operations of pulp suspensions in a pulp mill.

SECONDARY FIBER. Any type of paper- and paperboard-making fiber obtained from wastepapers and other used, reclaimable fiber sources.

SEMICHEMICAL PULP. Lower-quality pulp made by cooking fibrous materials in a neutral sodium sulfite/sodium carbonate cooking liquor followed by a final separation of the fiber using unpressurized mechanical means.

SHEET. Flat piece of any type of pulp, paper, and paperboard having a variety of characteristics, sizes, and finishes.

SILVICHEMICALS. Chemical byproducts of the woodpulping process and other chemicals derived from wood.

SIZE. Substance such as rosin, gelatins, glues, starch, or waxes added to paperstock furnish or to the surface of a sheet in order to give water-resistant properties.

SIZE PRESS. Paper mill processing unit consisting of two usually rubber-covered rolls located between two dry end sections of the paper machine. Applies size solution to the surface of the paper sheet.

SLURRY. Liquid mixture consisting of suspended fibers, fillers, coating pigments, and other solid material in water or adhesive, used in the papermaking process.

SLUSH. Pulp stockwater suspension thin enough to flow or to pump through a pipeline, usually running about 1% to 6% consistency.

SODA PULP. Pulp made by the cooking of woodchips from deciduous or broadleaf trees in a sodium hydroxide or caustic soda solution.

SOFTWOOD. Wood obtained from evergreen, cone-bearing species of trees, such as pines, spruces, hemlocks, etc., which are characterized by having needles.

SOLID BOARD. Single-ply, homogeneous types of paperboards, made from the same stock throughout the sheet structure.

SPENT LIQUOR. Used cooking liquor in a chemical pulp mill that is separated from the pulp after the cooking process. Contains lignins, resins, carbohydrates, and other substances extracted from the material being cooked.

SPLICE. Joint made in a continuous sheet of paper with glue or adhesive tape when a break occurs in the web during winding or rewinding into a roll.

STANDARD CONDITIONS. Unless otherwise specified, assumed to be 29.92 in. of mercury and 70°F.

STARCH. Type of papermaking adhesive and sizing material made primarily from corn and potatoes. Produces a higher degree of rigidity in a sheet and improves the finish by causing the fibers to lie flat.

STIFFNESS. The ability of paper or paperboard to withstand bending or crushing forces.

STOCK. (1) Fibrous mixture that is made into paper. May consist of one or more types of beaten or refined pulps, with or without suitable fillers, dyes, additives, and other chemicals. Also called *furnish.* (2) Paper suitable for a particular use, such as coating raw stock, milk bottle stock, tag stock, etc.

SULFATE PROCESS. An alkaline pulp manufacturing process in which the active components of the liquor used to cook chips in a pressurized vessel are primarily sodium sulfide and sodium hydroxide, with sodium sulfate and lime being used to replenish these chemicals in recovery operations. Also called *kraft process.*

SULFITE PROCESS. An acid pulp manufacturing process in which chips are reduced to their component parts by cooking in a pressurized vessel using a liquor composed of calcium, sodium magnesium, or ammonia salts of sulfurous acid.

SUPERCALENDER. Auxiliary piece of papermaking equipment used on some paper machines to obtain a denser paper with a higher finish than paper obtained on a calender.

SURFACE-COATED. Any paper or paperboard sheet that has a coating material applied to one or both surfaces.

SURFACE-SIZED. Paper whose surface is treated with a sizing material after the sheet is formed on a paper machine, or in a separate, off-machine operation, occasionally after it has been internally sized.

SYNTHETIC FIBERS. Short filaments that are extruded or spun from synthetic resin materials and used in the manufacture of synthetic paper.

T

TACK. Sticky property of paper and paperboard adhesive and glue-coating materials.

TALL OIL. Byproduct made from the resins, fatty acids, and soap removed during the evaporation of sulfate black liquor.

TARNISHPROOF PAPER. See *antitarnish paper.*

TEAR STRENGTH. Resistance of a paper sheet to tearing, usually measured by the force required to tear a strip under standardized conditions.

TENSILE STRENGTH. Resistant property of a sheet to pull or stress produced by tension. Expressed as the force per unit width of a sample that is tested to the point of rupture.

TEST LINERBOARD. Types of paperboard that meet specific tests (Rule 41) adopted by the packaging industry to qualify for use as the outer facing layer for corrugated board, from which shipping containers are made.

TEXT PAPER. Good-quality, laid or woven book paper with a medium vellum-like finish.

THERMOMECHANICAL PULP (TMP). Pulp made by presteaming chips and reducing them into their fiber components during an initial mechanical treatment in refiners under elevated temperature and pressure. Subsequent refining done at atmospheric pressure.

TRANSPARENCY. Ability of paper to allow light rays to pass through it in such a manner that objects behind it can be clearly seen.

TRIM. Dimension of the widest sheet of paper that can be made on a paper machine, not including the edges (which are normally cut off).

TWIN-WIRE FORMER. Type of multi-ply paperboard machine having two wires (or fabrics) between which the sheet is formed.

TWO-SIDEDNESS. Visual difference between the top or felt side of a sheet of paper and the bottom or wire side.

V-Y

VEGETABLE PARCHMENT. Hard, dense sheet of grease-resistant paper, having a very high wet-strength property.

VELLUM FINISH. Smooth, dull finish applied to book and stationery paper surfaces to simulate sheets originally made from young calves' skin.

WADDING. Single- or multi-ply, loosely matted fiber sheet made from chemical pulp and used in packaging, thermal, and acoustical applications, and as a cushioning medium. Also called cellulose wadding.

WASTEPAPER. All types of used paper that provide a source of fiber for the manufacture of some papers, paperboards, and chipboards.

WEB. Continuous sheet of paper produced and rolled up at full width on the paper machine.

WET END. Section of the head end of a paper machine, which includes the headbox, wire, and wet press sections. Where the sheet is formed from the stock furnish and where most of the water is removed before entering the dryer section. Also called *wire end.*

WET MACHINE. Paper machine consisting essentially of a wire-covered cylinder rotating in a vat of pulpstock on which a mat of varying thicknesses is formed by drainage. These mats are removed either intermittently in thick sheets called laps, or continuously.

WET-STRENGTH PAPER. Paper in which the fiber constituents and/or the sheet are chemically treated to enhance resistance to tear, rupture, or disintegration after becoming saturated with liquids.

WET TENSILE STRENGTH. Resistance of a paper sheet to pull or stress produced by applied tension after it has become saturated with liquids.

WHITE PAPER. (1) Any paper made from pulpstock whose natural color has been corrected by the addition of blue, yellow, and red dyestuff. (2) To a printer, any paper sheet that is devoid of printing material.

WIRE. See *fourdrinier wire.*

WIRE MARKS. Small impressions produced on the bottom surface of a sheet of paper, caused by the mesh of the wire screen on which the wet web is formed in the wet end of a paper machine.

WIRE SIDE. Bottom side of a sheet of paper that comes in contact with the wire as the web is being formed in the wet end of a paper machine.

WOODFREE. See *free-sheet.*

YANKEE DRYER. Type of steam-heated paper dryer consisting of a large, revolving drum equipped with a felt to hold the sheet in contact with its highly polished surface. Commonly used for drying tissue-type papers.

METRIC CONVERSION GUIDE

Reproduced from *Metrication for the Pulp and Paper Industry* by Kenneth E. Lowe (Miller Freeman Publications, 1975).

CONVERSION LIST FOR NORTH AMERICAN AND METRIC UNITS

To convert	Into	Multiply by
acre	hectare	0.4047
Btu (mean)	joule	1.05587×10^3
centimeter	foot	0.03281
	inch	0.3937
cord	(see Forestry Terms)	
foot	centimeter	30.48
	meter	0.3048
gallon (U.S. liquid)	gallon (U.K.)	0.8327
	liter	3.785
gallon (U.K.)	gallon (U.S. liquid)	1.20094
	liter	4.545
horsepower (electric)	kilowatt	0.746
horsepower-hour	kilowatt-hour	0.7457
inch	centimeter	2.54
	meter	0.0254
joule	Btu	9.4845×10^{-4}
	calorie (mean)	0.23866
kilogram-mass	pound (avdp)	2.2046
	ton (metric)	0.001
	ton (short)	1.102×10^{-3}
kilometer	foot	3281
	mile (statute)	0.6214
kilowatt	horsepower (electric)	1.3405
kilowatt-hour	horsepower-hour	1.3410
liter	gallon (U.K.)	0.21998
	gallon (U.S. liquid)	0.2642
meter	foot	3.281
ounce (avdp)	gram	28.3495
	pound (avdp)	0.0625
pound (avdp)	kilogram	0.4536
pound/inch^2 (psi)	kilogram-force/cm^2	0.07031
square foot	square centimeter (cm^2)	929.0
	square meter (m^2)	0.09290
square meter	square foot (ft^2)	10.76
	square inch (in.^{2})	1550
ton (long)	ton (metric)	1.016
	ton (short)	1.120
ton (metric)	ton (long)	0.9842
	ton (short)	1.1023
ton (short)	ton (long)	0.89286
	ton (metric)	0.90718
yard	centimeter	9.144
	meter	0.9144

FACTORS FOR CONVERTING REAM AND BASIS WEIGHTS TO GRAMMAGE

Paper grade	Trade size 500-sheet ream (in.)[1]	Grammage (g/m^2) to ream or basis weight[1]	Ream weight[2] to grammage
Writing and printing	17 x 22	0.266	3.760
Demy size	17½ x 22½	0.280	3.571
Blotting	19 x 24	0.324	3.083
Cover	20 x 26	0.370	2.704
Tissue (double-crown size)	20 x 30	0.427	2.343
Cardboard	22 x 28	0.438	2.282
Bristol and tag	22½ x 28½	0.456	2.195
News and wrapping (3000 ft^2)	24 x 36	0.614	1.627
Book	25 x 38	0.675	1.480
Former standard size	25 x 40	0.711	1.406
Paperboard	1000 ft^2	0.205	4.881

Note: If the conversion factor for a sheet size is not listed, the ream weight or grammage can be calculated by the following formulas:

- Converting ream weight (lb/500 sheets) to grammage:

$$g/m^2 = \frac{\text{ream weight} \times 1406}{\text{sheet area in square inches}}$$

- Converting grammage to ream weight in lb/500 sheets:

$$\text{lb/ream} = g/m^2 \times \text{sheet area in square inches} \times 0.000711$$

1. If the given trade size is in 480 sheets, then factor should be multiplied by 48/50 (or 0.960).
2. If the given trade size is 480 sheets, then factor should be multiplied by 1.042.

Source: Based on TAPPI Standard T410.

COMPARISON OF ISO AND NORTH AMERICAN PAPER SIZES

ISO sizes			North American sizes		
	Millimeters	Inches		Millimeters	Inches
A0	841 x 1189	33⅛ x 46¾	NA0	889 x 1143	35 x 45
A1	594 x 841	23⅜ x 33⅛	NA1	559 x 864	22 x 34
A2	420 x 594	16½ x 23⅜	NA2	432 x 559	17 x 22
A3	297 x 420	11⅔ x 16½	NA3	279 x 432	11 x 17
A4	210 x 297	8¼ x 11¾	NA4	216 x 279	8½ x 11
A5	148 x 210	5⅞ x 8¼	NA5	139 x 216	5½ x 8½
A6	105 x 148	4⅛ x 5⅞	NA6	108 x 139	4¼ x 5½

METRIC UNITS FOR WIDELY USED TERMS IN FORESTRY

Term	North American symbol or definition	Suggested metric unit	Equivalent
LAND AREA			
Acre		hectare (ha)	1 acre = 0.4047 ha
Square mile	640 acres	hectare (ha)	1 mi^2 = 259.0 ha
		square kilometer (km^2)	1 mi^2 = 2.59 km^2
Section	640 acres	hectare (ha)	1 section = 259.0 ha
Township	36 square miles (mi^2)	hectare (ha)	1 township = 9324 ha
LUMBER AND BOARD MEASUREMENTS			
Board foot	bdf	cubic meter (m^3)	1 bdf = 0.002360 m^3
1000 board feet	1000 bdf	cubic meter (m^3)	1000 bdf = 2.360 m^3
Cubic foot	ft^3	cubic meter (m^3)	1 ft^3 = 0.02832 m^3
Square foot	ft^2	square meter (m^2)	1 ft^2 = 0.09290 m^2
Thickness	in.	millimeter (mm)	1 in. = 25.4 mm
WOOD AND PULPWOOD MEASUREMENTS			
Cord	128 ft^3	cubic meter (m^3)	1 cord = 3.624 m^3
Unit	160 ft^3 (wood)	cubic meter (m^3)	1 unit (160 ft^3) = 4.528 m^3
	200 ft^3 (chip)	cubic meter (m^3)	1 unit (200 ft^3) = 5.664 m^3
Cunit	100 ft^3 (solid)	cubic meter (m^3)	1 cunit = 2.832 m^3
Cubic foot	ft^3	cubic meter (m^3)	1 ft^3 = 0.02832 m^3
Yield/acre	ft^3/acre	cubic meter/hectare (m^3/ha)	1 ft^3/acre = 0.06998 m^3/ha

CONVERSIONS FOR ACCOUNTING

(continued next page)

Unit cost	Multiply by	To obtain
AREA		
$/acre	2.47105	$/hectare
$/square foot	10.7639	$/square meter
$/1000 square feet	0.0107639	$/square meter
	10.7639	$/1000 square meters
$/3000 square feet	0.0035879	$/square meter
ELECTRICAL		
$/kilowatt-hour	1.0	$/kilowatt-hour
	0.277778	$/megajoule
ENERGY		
$/cubic foot (gas)	35.3147	$/cubic meter
$/1000 cubic feet (gas)	35.3147	$/1000 cubic meters
$/gallon (U.S.)	(see *Volume*)	
$/gallon (U.K. liquid)	(see *Volume*)	
FREIGHT		
$/ton (2000 lb)	(see *Weight*)	$/metric ton
$/ton-mile	0.6849	$/metric ton-kilometer
LABOR		
ton (2000 lb)/man-day	0.9072	metric tons/man-day
$/ton (2000 lb)	1.10231	$/metric ton

CONVERSIONS FOR ACCOUNTING

(continued)

Unit cost	Multiply by	To obtain
VOLUME		
$/gallon (U.S.)	0.264173	$/liter
	264.173	$/cubic meter
$/gallon (U.K.)	0.219969	$/liter
	219.969	$/cubic meter
$/1000 gallons (U.S.)	0.264173	$/1000 liters
	0.264173	$/cubic meter
$/million gallons (U.S.)	0.264173	$/1000 cubic meters
$/cubic foot	35.3147	$/cubic meter
$/cubic yard	1.30795	$/cubic meter
WEIGHT (mass)		
$/pound	2.20462	$/kilogram
$/100 pound (CWT)	0.0220462	$/kilogram
$/short ton (2000 lb)	1.10231 (0.9072)	$/metric ton
$/long ton (2240 lb)	0.984206	$/metric ton
WOOD VOLUME		
$/board foot	423.76	$/cubic meter
$/1000 board feet	0.42376	$/cubic meter
$/cubic foot	35.3147	$/cubic meter
$/cord (128 ft³)	0.2759	$/cubic meter
$/unit (wood)	0.2208	$/cubic meter
$/unit (chip)	0.1766	$/cubic meter
$/cunit (100 ft³)	0.3531	$/cubic meter

For example, assume the selling price for 42-lb linerboard is $300/ton. Calculate the price per 1000 m²:

$$\frac{300 \times 42.0}{2000} = \$6.30/1000\ \text{ft}^2\text{; thus}$$

$$6.30 \times 10.764 = \$67.81/1000\ \text{m}^2$$

Another formula for calculating price on a 1000-square-meter basis is:

$$\$/1000\ \text{m}^2 = (\$/\text{metric ton})\ (\text{grammage})\ (0.001)$$

For example, assume that the selling price of linerboard with a grammage of 205 g/m² is $400/metric ton. Calculate the price per 1000 m²:

$$400 \times 205 \times 0.001 = \$82.00/1000\ \text{m}^2$$

SOURCES OF INDUSTRY INFORMATION

Advertisers & Publishers Service Inc.
300 N. Prospect Ave., Park Ridge, Ill. 60068
- SOS/Sources of Supply Buyers Guide (annual)

Allen/Abernethy Publishing Div. of ASM Communications
75 Third St. N.W., Atlanta, Ga. 30365
- American Papermaker (in four regional editions; monthly except bimonthly in October)

American Paper Institute
260 Madison Ave., New York, N.Y. 10016
- Dictionary of Paper (4th edition, 1980)
- Exports of Kraft Linerboard and Corrugating Material (annual)
- Fiber Statistics Subscription Service
- International Report (intermittent)
- Paper, Paperboard, Wood Pulp Capacity (annual)
- Paper, Paperboard & Wood Pulp/Monthly Statistical Summary
- Paper Production Report (weekly)
- Statistics of Paper, Paperboard & Wood Pulp (annual)
- U.S. Exports of Pulp, Paper, Paperboard and Converted Products (annual)
- U.S. Exports of Wastepaper by Destination (annual)
- U.S. Woodpulp Data (monthly)
- Wood Pulp & Fiber Statistics (annual)

American Newspaper Publishers Assn.
Box 17407, Dulles International Airport
Washington, D.C. 20041
- Presstime (monthly)

American Pulpwood Assn.
1619 Massachusetts Ave. N.W.
Washington, D.C. 20036
- Monthly Pulpwood Summary

Arnold Services
106 Runcorn Road, Moore, Warrington WA4 6UB, U.K.
- Yeast from Spent Sulphite Liquor: Manufacture and Marketing

Assn. of Nonwoven Fabrics Industry
1700 Broadway, New York, N.Y. 10019
- International Directory of the Nonwoven Fabrics Industry (biennial)

Benn Publications Ltd.
Sovereign Way, Tonbridge, Kent TN9 1RW, U.K.
- Paper (semi-monthly)

Business Press Inc.
70 Oak St., Norwood, N.J. 07648
- Paper Age (monthly)

Business Trend Analysts
2171 Jericho Turnpike, Commack, N.Y. 11725
- The Corrugated and Paperboard Container Industry: An Analysis of Current Markets and Prospects for Future Growth (1986)
- U.S. Market for Household Paper Products: A Strategic Marketing Analysis and Biennial Review

Canadian Paper Analyst (monthly)
Box 300, Victoria Station
Westmount, Que. H3Z 2V5, Canada

Canadian Pulp & Paper Assn.
2300 Sun Life Bldg., 1155 Metcalfe St.
Montreal, Que. H3B 2X9, Canada
- Canadian Market Pulp Statistics (monthly)
- Canadian Pulp and Paper Capacity (annual)
- Monthly Newsprint Statistics
- Newsprint Data (annual)
- Reference Tables (annual)
- Statistical Bulletin (monthly)

Central Assn. of Finnish Forest Industries
Eteläesplanadi 2, SF-00130 Helsinki, Finland
- Finnish Forest Industries, 1987

Communication Conseil International
96, rue Montmartre, 75002 Paris, France
- Papercast (monthly)

Data Resources
24 Hartwell Avenue, Lexington, Mass. 02173
- Annual Survey of U.S. Businesses' Plans for New Plants and Equipment (McGraw-Hill Capital Spending Surveys)

Data-Transcripts
Box 14, Dorking, Surrey RH5 4YN, U.K.
- Kraftliner Price Movements vs Supply & Demand Shifts Since 1974
- Specialty Papers and Boards Worldwide Trends & Developments
- Specialty Papers and Products Record (monthly)
- Thermal & Dielectric Papers—Technology, Markets & Company Data

Euro-Data Analysts
Box 13, Dorking, Surrey RH5 4YL, U.K.
- Cost Effective Product Development & Marketing in Paper & Board Mills (1986)

European Paper Institute
42, rue Galilée, F- 75116 Paris, France
- Paper Capacity Report (annual)

Fibre Box Assn.
5725 N. East River Road, Chicago, Ill. 60631
- Fibre Box Industry Annual Report
- Statistical Bulletin/Containerboard Shipments, Consumption, Inventory (monthly)

Food & Agriculture Organization, United Nations
Via della Terme di Caracalla, I- 00100 Rome, Italy
- Estimated Production of Pulp, Paper and Paperboard in Certain Countries (annual)
- Projected Pulp and Paper Mills in the World (annual)
- Pulp and Paper Capacities (annual)

Frost & Sullivan Inc.
106 Fulton St., New York, N.Y. 10038
- Paper Chemicals (1987)

Grade Finders Inc.
Box 944, Exton, Pa. 19341
- Competitive Grade Finder for the Paper and Graphic Arts Industry (annual)

Harcourt Brace Jovanovich Inc.
111 E. Wacker Dr., Chicago, Ill. 60601
- Official Board Markets (weekly)

Harcourt Brace Jovanovich Inc.
120 W. Second St., Duluth, Minn. 55802
- Paper Year Book (annual)
- Paper Sales (monthly)

Harcourt Brace Jovanovich Inc.
7500 Old Oak Blvd., Cleveland, Ohio 44130
- Paperboard Packaging (monthly)

Hatton Brown Publishers
610 S. McDonough St., Montgomery, Ala. 36197
- Paper Industry Equipment (bimonthly)

Hilary House Publishers Inc.
1033 Channel Dr., Hewlett Harbor, N.Y. 11557
- Printing and Graphic Arts Buyers (annual)

Indufor Ky
Kapteeninkatu 14, Box 121, SF-00141, Helsinki, Finland
- Future Prospects of the Soviet Pulp and Paper Industry

International Paper Co.
2 Manhattanville Road, Purchase, N.Y. 10577
- Pocket Pal/Graphic Arts Production Handbook

Jaakko Pöyry Oy
Box 16, SF-00441 Helsinki, Finland
- Annual Review of Pulp and Paper Mill Projects Worldwide (annual)
- Monthly Report on Pulp and Paper Mill Projects in the World (11 issues/year)
- Short-term Review of International Pulp & Paper Markets, Worldwide (quarterly)

Japan Paper Assn.
Kami-Parapu Kaikan Bldg., 9-11 Ginza 3-chome
Chuo-ku, Tokyo, Japan
- Pulp & Paper Statistics (annual)

Laves Chemie
Hamburger Allee 12, D-6000 Frankfurt 90, Fed. Rep. Germany
- Carbonless Copy Paper, 1980 through 1990 (5th edition)

Maclean-Hunter Ltd.
777 Bay St., Toronto, Ont. M5W 1A7, Canada
- Pulp and Paper Journal (9 times/year and directory/desk calendar)

Maclean-Hunter Publishing Corp.
300 W. Adams St., Chicago, Ill. 60606
- Boxboard Containers (monthly)
- Paper, Film & Foil Converter (monthly)

Marketing/Technology Service Inc.
4100 South Seventh St., Kalamazoo, Mich. 49009
- North American Fluff Pulp Markets and Prospects for 1986-96

Market News Publishing Corp.
156 Fifth Ave., New York, N.Y. 10010
- Fibre Market News (two times/week)

Merrill Lynch, Pierce, Fenner & Smith Inc.
Securities Research Div.
165 Broadway, New York, N.Y. 10080
- Forest Products and Paper Industry (monthly)

Miller Freeman Publications
500 Howard St.
San Francisco, Calif. 94105
- International Glossary of Technical Terms for the Pulp and Paper Industry (1976)
- Lockwood-Post's Directory of the Pulp and Paper and Allied Trades (annual)
- Map of the European Pulp & Paper Industry (1984)
- Market Pulp Survey
- Mill-by-Mill Listings of Capital Spending Programs (semiannual)
- Nonwovens Markets (25 issues/year)

- Paper Recycler (monthly)
- PaperTree Letter (monthly)
- PPI/Capital Investment Service (update on order)
- PPI/International Fact & Price Book (biennial)
- PPI/International Pulp & Paper Directory (biennial)
- PPI/This Week (weekly—48 times/year)
- PPI/Top 150 Companies in the World (annually in September)
- PULP & PAPER (monthly except twice in November)
- PULP & PAPER Buyers Guide (annual)
- Pulp & Paper Dictionary By John R. Lavigne
- PULP & PAPER Forecaster (bimonthly)
- PULP & PAPER INTERNATIONAL (monthly)
- Pulp & Paper Mills in the U.S. & Canada (map, 1988)
- PULP & PAPER Project Report (monthly, with semiannual Mill-by-Mill Listings supplement)
- PULP & PAPER WEEK (weekly—48 times/year)
- Synthetic Polymers and the Paper Industry By Vladimir M. Wolpert

Morgan Stanley, Investment Research
1251 Ave. of the Americas, New York, N.Y. 10020
- Paper Industry Monthly by Thomas P. Clephane and Jeanne Carroll

National Assn. of Recycling Industries Inc.
330 Madison Ave., New York, N.Y. 10017
- Monthly Paper Stock Statistics

National Forest Products Assn.
1250 Connecticut Ave. N.W., Suite 200
Washington, D.C. 20036
- International Trade Report (monthly)

National Paper Trade Assn.
111 Great Neck Road, Great Neck, N.Y. 11021
- Paper Merchant Performance (annual)
- Paper Merchant Sales Report (monthly)
- The Paper Distribution Industry (annual)
- Who's Who in Paper Distribution (annual)

OECD/Organization for Economic Cooperation and Development, Paris, France
OECD Publications Center
1750 Pennsylvania Ave. N.W., Washington, D.C. 20006
- Pulp and Paper/Quarterly Statistics (quarterly)

Pacific Northwest Forest & Range Experiment Station, Forest Service, U.S. Dept. of Agriculture
809 N.E. 6th Ave., Portland, Ore. 97232
- Production, Prices, Employment & Trade in Northwest Forest Industries (quarterly)

PAPIS Ltd.
Collingham House, Gladstone Road
Wimbledon, London SW19 1QH, U.K.
- Pulp Buyers Survey

Pima (Paper Industry Management Assn.)
2400 E. Oakton St., Arlington Heights, Ill. 60005
- Pima (monthly)
- Pima Pulp & Paper Mill Catalog (annual)

Resource Information Systems Inc.
110 Great Road, Bedford, Mass. 01730
- Paper Packaging Monitor (monthly)
- Paper Trader (monthly)
- World Pulp Monthly

Southam Business Publications
310 Victoria Ave., Westmount, Que. H3Z 2M9, Canada
- Pulp & Paper Canada (monthly)
- Pulp & Paper Canada Annual and Directory (annual)

Statistics Canada
Publications Distribution, User Services Div.
Ottawa, Ont. K1A 0T6, Canada
- Canada: Exports by Commodities and Countries (Catalog 65-004—includes pulp and paper grades; monthly)
- Canada: Imports by Commodities and Countries (Catalog 65-007—includes pulp and paper grades; monthly)
- Pulp and Paper Mills (Catalog No. 36-204—annual)
- Pulpwood and Wood Residue Statistics (Catalog No. 25-001—monthly)

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402
- U.S. Imports, Schedule A, Commodity by Country (Catalog FT135—includes pulp & paper grades; monthly)
- U.S. Exports, Schedule E, Commodity by Country (Catalog FT410—includes pulp & paper grades; monthly)
- 1987 Census of Manufactures

Pulp Mills (SIC 2611)
Paper Mills (SIC 2621)
Paperboard Mills (SIC 2631)
- Current Industrial Reports: Pulp, Paper & Board—M26A (annual)
- U.S. Industrial Outlook

Swedish Pulp and Paper Assn.
Villagatan 1, S-114 32 Stockholm, Sweden
- SCPF Annual Report

TAPPI (Technical Assn. of Pulp & Paper Industry)
15 Technology Park South, Norcross, Ga. 30092
- Tappi Journal (monthly)
- Tappi Journal Directory (annual)

Timber Mart—South Inc.
Box 1278, Highlands, N.C. 28741
- Timber Mart—South (monthly)

University of Wisconsin
432 North Lake St., Madison, Wis. 53706
- Wisconsin Forest Products Price Review (three segments, quarterly or semi-annually)

Walden-Mott Corp.
475 Kinderkamack Road, Oradell, N.J. 07649
- Walden's ABC Guide and Paper Production Yearbook (annual)
- Walden's Fiber & Board Report (semimonthly)
- Walden's Handbook/For Paper Salespeople and Buyers
- Walden's Paper Catalog (2 times a year, in 6 regional editions)
- Walden's Paper Report (twice monthly)

Wood Fibre Northwest (quarterly)
Box 572, Albany, Ore. 97321

COMPANY PROFILES

This section is a listing of U.S. and Canadian companies with daily production capacity of at least 1,000 short tons (U.S.) or 900 metric tpd (Canada), counting facilities for pulp, paper, and paperboard.

Operations are listed under the name of the corporate owner, except when the owner is not in the pulp/paper/board industry. Subsidiaries and joint ventures in the U.S. and Canada are included under the parent firm. Foreign operations are not listed.

Sales and earning figures (when available) are given for 1985 to 1989, and a brief description of each company follows. Pulp and paper/board production sites—with capacity and grades—are also listed. All pulp produced at a millsite, whether shipped as market pulp or consumed onsite in papermaking, is counted.

Financial data:	All sales and earnings figures are shown in U.S. dollars, unless indicated "C$" for Canadian dollars.
Production data:	All capacity production data are set in short tons of 2,000 lb, unless specifically indicated as metric. To convert to metric tons—multiply by 0.90718. To convert to short tons—multiply by 1.1023.

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Abitibi-Price Inc.

207 Queens Quay West
Suite 680, P.O. Box 102
Toronto, Ont. M5J 2P5
Bernd K. Koken, chairman/chief executive officer; Ron Y. Oberlander, President/chief operating officer

(Olympia & York Developments Ltd. had increased its ownership from 74.8% of Abitibi-Price to 82.0% by early 1990. Abitibi has two joint ventures: Gaspesia Pulp & Paper Co., subsidiary of Price, 51% [New York Times, 49%]; and Augusta Newsprint Co., 50% [Thomson Newspapers Ltd., 50%].)

Net sales:	
1989	C$3,257,700,000
1988	3,304,500,000
1987	2,988,000,000
1986	2,763,500,000
1985	2,549,800,000
Net earnings:	
1989	C$54,200,000
1988	191,100,000
1987	125,700,000
1986	107,300,000
1985	100,200,000

Abitibi-Price is one of the world's largest producers of both newsprint and uncoated groundwood papers, with an annual capacity of 2.44 million metric tons (55% of total revenues). The company is emphasizing expansion into higher-value paper grades and paper distribution. About 90% of total sales result from pulp, paper, paperboard, and converting operations.

Abitibi-Price's core business is newsprint (nine mills) and groundwood papers (three mills). Provincial Papers, the company's coated paper operation, produces about 140,000 metric tpy of coated paper.

Sales of printing papers in 1989 were as follows: newsprint, C$1,058.9 million; groundwood papers, C$362.9 million; and coated papers, C$144.6 million.

Newsprint capacity in 1990 was 1,953,000 metric tons; groundwood papers, 443,000 tons; and coated papers, 174,000 tons. Production of newsprint in 1989 was 1,791,000 tons; groundwood papers, 416,000 tons; and coated paper, 140,000 tons.

Capital expenditures were C$204 million in 1988 and $260 million in 1989. Spending was expected to reach C$150 million in 1990.

Abitibi plans to continue with its current strategy of reducing capacity and downsizing operations as required in areas of declining demand while proceeding with new projects that take advantage of local conditions and key markets.

Abitibi's Alabama River Newsprint joint venture with Parsons & Whittemore Inc. remains on schedule and on budget. The 220,000-metric-tpy newsprint mill should come onstream as planned in 1990.

Abitibi is also involved in a partnership with the Venezuelan government, Venezuelan newspaper publishers, and Bowater Inc. to build a 200,000-tpy greenfield newsprint mill that is expected to be completed sometime in the early 1990s.

In response to the increasing demand for recycled products, the company announced the conversion of part of its newsprint mill in Augusta, Ga., to recycled fiber and is studying a similar opportunitiy in Ontario. Abitibi is also studying a joint venture to build a recycled-fiber newsprint mill in Gartcosh, Scotland.

The company's 1990 performance was hampered by a 10-week strike by the Canadian Paperworkers Union at seven mills, involving over 3,000 workers.

Abitibi owns 1,641 mi² of timberlands in Canada and controls another 27,495 mi². In the U.S., it owns 134 mi² and controls 110 mi².

Production facilities:

PINE FALLS, MAN.
Pulp—136 metric tpd sulfite; 408 metric tpd groundwood
Newsprint—465 metric tpd

GRAND FALLS, NFLD.
Pulp—250 metric tpd sulfite; 800 metric tpd thermomechanical
Newsprint—705 metric tpd

STEPHENVILLE, NFLD.
(Stephenville Div.)
Pulp—600 metric tpd thermomechanical
Newsprint—475 metric tpd

GEORGETOWN, ONT.
(Provincial Papers, Port Arthur Div.)
Printing/writing papers—45 metric tpd

IROQUOIS FALLS, ONT.
Pulp—250 metric tpd sulfite; 760 tpd groundwood
Newsprint—825 metric tpd

THUNDER BAY, ONT.
(Provincial Papers)
Pulp—61 metric tpd groundwood
Printing/writing papers—385 metric tpd

THUNDER BAY, ONT.
(Fort William Div.)
Pulp—136 metric tpd sulfite (SCMP); 299 tpd groundwood
Newsprint—385 metric tpd

THUNDER BAY, ONT.
(Thunder Bay Div.)
Pulp—136 metric tpd sulfite; 408 tpd groundwood
Newsprint—455 metric tpd

ALMA, QUE.
Pulp—218 metric tpd sulfite; 708 tpd groundwood
Newsprint—375 metric tpd
Uncoated groundwood—270 metric tpd

BEAUPRÉ, QUE.
Pulp—550 metric tpd thermo-chemical mechanical pulp (TCMP)
Uncoated groundwood—400 metric tpd

CHANDLER, QUE.
(Gaspesia Pulp & Paper Co.)
Pulp—408 metric tpd groundwood; 36 tpd refiner mechanical; 250 tpd bisulfite chemimechanical (BCMP)
Newsprint—650 metric tpd

JONQUIÈRE, QUE.
Pulp—299 metric tpd groundwood; 327 tpd TCMP
Uncoated groundwood—600 metric tpd

LaCHUTE, QUE.
(Price Wilson)
Packaging, toweling paper—21 metric tpd

AUGUSTA, GA.
(Augusta Newsprint Co.)
Pulp—496 short tpd (450 metric) groundwood; 772 short tpd (700 metric) thermomechanical
Newsprint—1,075 short tpd (975 metric)

Total production capacity:

PULP	
Groundwood	3,801 metric tpd
SCMP	136 metric tpd
BCMP	250 metric tpd
Refiner mechanical	36 metric tpd
Sulfite	990 metric tpd
TCMP	877 metric tpd
Thermomechanical	2,100 metric tpd
Total	8,190 metric tpd
PAPER	
Newsprint	5,310 metric tpd
Groundwood	1,270 metric tpd
Printing/writing	430 metric tpd
Packaging/toweling	21 metric tpd
Total	7,031 metric tpd

Appleton Papers Inc.

825 E. Wisconsin Ave.
Box 359
Appleton, Wis. 54912
Gordon Bond, chairman/chief executive officer

(Appleton Papers Inc. and Wiggins Teape Group were combined under a publicly held holding company run by management from the two firms. The new company is now called Wiggins Teape Appleton plc, and its spinoff from B.A.T Industries plc was scheduled to be effective June 1, 1990. B.A.T was forced to divest itself of some properties during its fight against a hostile takeover bid.)

Net sales:	
1989	$911,000,000
1988	844,076,000
1987	779,312,000
1986	723,211,000
1985	639,139,000
1984	572,712,000
Operating income:	
1989	$151,000,000
1988	131,072,000
1987	126,317,000
1986	134,342,000
1985	112,144,000
1984	105,358,000

Appleton is the world's leading producer of carbonless copy paper. It also produces thermal-grade paper, high-quality graphic arts products, and specialty coated papers. The company has converting/coating/finishing plants, capsular plants, and a chemical plant.

Although carbonless paper has long been Appleton's bread and butter, the company announced in early 1989 that it would establish a business unit dedicated solely to thermal paper. This area of Appleton's business is thriving with the proliferation of facsimile machines and bar-coded pressure-sensitive labels. In 1988, the company added a thermal paper coating machine at its finishing plant in Appleton, Wis., which more than doubled company-wide thermal paper capacity

Since acquiring the West Carrollton mill in 1984, Appleton has rebuilt all three of its paper machines and dedicated them solely to producing carbonless paper. The company has the same agenda in mind for its two other mills during 1990-91. Two of three paper machines at Roaring Spring, Pa., and two of four paper machines at Combined Locks, Wis., are slated for rebuilds.

In September 1990, the company said that is plans to buy a Vancouver, Wash., paper mill from Boise Cascade Corp. for about $60 million. The 105,000-tpy acquisition will increase the company's carbonless capacity about 20%. Appleton also agreed to purchase finished goods at the mill, bringing the transaction value to about $72 million. Appleton has a five-year capital plan for the mill, but details are not currently available.

Production facilities:

WEST CARROLLTON, OHIO
(West Carrollton mill)
Pulp—180 tpd bleached deinked
Carbonless paper—350 tpd

ROARING SPRING, PA.
(Spring mill)
Pulp—250 tpd bleached kraft
Carbonless paper—273 tpd

COMBINED LOCKS, WIS.
(Locks mill)
Pulp—200 tpd chemimechanical
Carbonless paper—530 tpd

Total production capacity:

PULP	
Kraft	250 tpd
Chemimechanical	200 tpd
Deinked	180 tpd
Total	630 tpd
PAPER	1,153 tpd

Boise Cascade Corp.

One Jefferson Sq.
P.O. Box 50
Boise, Idaho 83728-0001
John B. Fery, chairman/chief executive officer

(Boise owns Boise Cascade Canada.)

Net sales:	
1989	$4,338,030,000
1988	4,094,630,000
1987	3,820,810,000
1986	3,739,970,000
1985	3,737,220,000
Net income:	
1989	$267,580,000
1988	289,120,000
1987	182,990,000
1986	101,540,000
1985	104,290,000

In its paper segment, Boise Cascade has positioned itself in communications papers, primarily business papers made from uncoated free-sheet and publication papers such as coated white papers, uncoated groundwood, and newsprint.

Paper, paperboard, and converted products accounted for 55% of the company's total sales in 1989. Operating income for paper and paper products was $405 million. Paper sales volume was about 3.3 million tons.

The company's capital expenditures totaled over $4.3 billion during the 1979-89 period. Of the $723 million spent in 1989, approximately $602 million went to the paper and paper products segment. Boise earmarked $700 million for capital spending in 1990.

Boise has encountered some delays and added expenses for its expansion and modernization program at International Falls, Minn., which includes installation of a 210,000-tpy uncoated free-sheet machine and two high-pressure boilers, to provide for future cogeneration capacity. Startup of the project, which will increase the mill's production capacity from 205,000 to 505,000 tpy, was moved up to December 1990 despite labor problems at the mill.

During 1989, Boise announced its intent to build a new coated paper machine and related facilities at its paper mill in Rumford, Maine. Although exact timing of the $450-million project depends on market conditions, construction could begin in 1991. Based on that, startup is anticipated for late 1993.

On June 30, 1989, the company sold its specialty paperboard mills, and in September 1990, announced it would sell its Vancouver, Wash., carbonless paper mill to Appleton Papers for about $60 million. The sale was part of Boise's announced plan to trim its presence in the U.S. Pacific Northwest.

Boise owns in fee 2.9 million acres of timberland, and it controls about 3.4 million more through long-term leases, contracts, and licenses.

Production facilities:

White Paper Div.

JACKSON, ALA.
(Former Allied Paper Co. mill)
Pulp—589 tpd bleached kraft (365 for market)
Uncoated free-sheet—253 tpd

INTERNATIONAL FALLS, MINN.
Pulp—420 tpd bleached kraft
Uncoated free-sheet—559 tpd

ST. HELENS, ORE.
Pulp—854 tpd bleached kraft
Uncoated free-sheet—602 tpd

VANCOUVER, WASH.
Uncoated free-sheet—298 tpd
(Sold to Appleton Papers in September.)

WALLULA, WASH.
Pulp—829 tpd bleached kraft (345 tpd for market); 190 tpd semichemical
Uncoated free-sheet—540 tpd
Containerboard—302 tpd

Coated & Specialty Converting Paper Div.

RUMFORD, MAINE
Pulp—1,062 tpd bleached kraft; 170 tpd groundwood; 165 tpd thermomechanical
Coated paper—1,200 tpd
Uncoated free-sheet—300 tpd

Publishing & Packaging Paper

DeRIDDER, LA.
(Boise Southern Co.)
Pulp—1,178 tpd unbleached kraft; 290 tpd bleached kraft; 406 tpd groundwood; 411 tpd thermomechanical
Newsprint—1,069 tpd
Containerboard—1,160 tpd

STEILACOOM, WASH.
Pulp—469 tpd thermomechanical
Newsprint—532 tpd

FORT FRANCES, ONT.
(Boise Cascade Canada)
Pulp—449 metric tpd (495 short) groundwood; 544 metric tpd (600 short) bleached kraft (333 tpd for market)
Uncoated groundwood papers—699 metric tpd (771 short)

KENORA, ONT.
(Boise Cascade Canada)
Pulp—542 metric tpd (598 short) groundwood; 280 metric tpd (309 short) sulfite
Newsprint—860 metric tpd (948 short)

Total production capacity:

PULP	
Kraft	5,555 tpd
Groundwood	1,715 tpd
TMP	1,030 tpd
Sulfite	270 tpd
Semichemical	180 tpd
Total	8,750 tpd
PAPER AND BOARD	
Uncoated free-sheet	2,625 tpd
Newsprint	2,460 tpd
Coated	1,130 tpd
Uncoated groundwood	765 tpd
Containerboard	1,465 tpd
Specialty paperboard	280 tpd
Total	8,725 tpd

Bowater Inc.

One Parklands Drive, Box 4012
Darien, Conn. 06820-1412
Anthony P. Gammie,
chairman/president/chief executive officer

(Bowater owns 51% of Catawba Newsprint Co. [Newhouse Newspaper Group, 49%] and 51% of Mersey Paper Co. Ltd. [The Washington Post, 49%].)

Net sales:	
1989	$1,449,980,000
1988	1,410,411,000
1987	1,231,002,000
1986	919,690,000
1985	904,004,000
Net income:	
1989	$144,569,000
1988	164,317,000
1987	81,140,000
1986	49,444,000
1985	67,520,000

Spun off by its English parent as an independent company in 1984, Bowater is a major producer of newsprint (about 68% of its capacity), coated publication paper, and market pulp. It is the largest U.S. manufacturer of newsprint and the fourth largest in North America. Bowater has diversified into the forms business, and in 1987 it doubled operations through the acquisition of Star Forms Inc.

Sales in 1989 were $645 million for newsprint, $279 million for coated paper, $183 million for market pulp, and $310 million for computer forms.

Production in 1989 was 1,271,300 tons of newsprint, 341,900 tons of coated paper, and 262,400 tons of market pulp.

Capital expenditures in 1989 totaled $423.4 million, and the company planned to spend $235 million in 1990.

Bowater is involved in a partnership with the Venezuelan government, Venezuelan newspaper publishers, and Abitibi-Price Inc. to build a 200,000-tpy greenfield newsprint mill that will be completed in the early 1990s.

In February 1990, Bowater Southern started up a new 900-tpd (320,000-tpy) bleached kraft pulp mill that will replace the existing unit at Calhoun, Tenn. Besides supplying pulp to the newsprint machines, it is capable of producing 220 tpd (80,000 tpy) of market pulp.

In late 1989, Bowater Mersey commissioned a new 700-tpd thermomechanical pulp (TMP) mill at its newsprint mill at Liverpool (Brooklyn), N.S. This new TMP mill replaced the groundwood and sulfite mills. Furnish to the paper machines is now 100% TMP. Following the completion of the paper machine modifications in early 1991, the newsprint capacity is expected to increase from 670 to 805 tpd (245,000 to 290,000 tpy).

Bowater owns or leases over 1.8 million acres of timber.

Production facilities:

CATAWBA, S.C.
(Bowater Carolina Co.)
Pulp—1,300 tpd bleached kraft (720 tpd for market); 380 tpd thermomechanical
Coated publication paper—940 tpd

CATAWBA, S.C.
(Catawba Newsprint Co.)
Pulp—615 tpd thermomechanical
Newsprint—680 tpd

CALHOUN, TENN.
(Bowater Southern Paper Co.)
Pulp—900 tpd semibleached kraft; 700 tpd groundwood; 1,050 tpd thermomechanical
Newsprint—2,165 tpd

LIVERPOOL (Brooklyn), N.S.
(Bowater Mersey Paper Co.)
Pulp—880 tpd thermomechanical
Newsprint—670 tpd

Total production capacity:

PULP	
Kraft	2,200 tpd
Groundwood	700 tpd
TMP	2,925 tpd
Total	5,825 tpd
PAPER	
Coated	940 tpd
Newsprint	3,515 tpd
Total	4,455 tpd

Brant-Allen Industries Inc.

(Formerly Bato Co. Inc.)
80 Field Point Road
Greenwich, Conn. 06830
Peter M. Brant, chief executive officer

(F.F. Soucy Inc. is a wholly owned subsidiary. Brant-Allen owns 50% of F.F. Soucy Inc. et Associés [Dow Jones owns 40% and Rexfor 10%]. Brant-Allen is joint owner of Bear Island Paper Co. with Dow Jones and Washington Post.)

Financial data not available.

Brant-Allen, an integrated manufacturer, was considering a new 225,000-tpy, $400-million newsprint machine and pulp mill for Bear Island Paper in Ashland, Va. The company has said that it will install deinking facilities there once a pattern of state recycling laws and market needs has been established.

Based on the same criteria, F.F. Soucy Inc. et Associés' mill in Rivière-du-Loup, Que., also plans to install deinking facilities. In addition, the company is considering a plan to rework the press section on No. 1 machine and install a new pickup combination press, which would add 9,000 tpy to capacity.

The company owns 235,000 acres of timberlands in the U.S.

Production facilities:

ASHLAND, VA.
(Bear Island Paper Co.)
Pulp—625 tpd thermomechanical
Newsprint—580 tpd

RIVIÈRE-du-LOUP, QUE.
(F.F. Soucy Inc.)
Pulp—490 metric tpd (540 short) thermomechanical
Newsprint—151 metric tpd (166 short)

RIVIÈRE-du-LOUP, QUE.
(F.F. Soucy Inc. et Associés)
Newsprint—364 metric tpd (401 short)

Total production capacity:

PULP	
Thermomechanical	1,165 tpd
PAPER	
Newsprint	1,147 tpd

Canadian Pacific Forest Products Limited

1155 Metcalfe St.
Montreal, Que. H3B 2X1
Cecil S. Flenniken, chairman/president/chief executive officer

Net sales:	
1989	C$2,876,400,000
1988	3,005,900,000
1987	2,764,700,000
1986	2,316,700,000
Net earnings:	
1989	C$220,100,000
1988	323,400,000
1987	214,000,000
1986	33,300,000

Canadian Pacific Forest Products Ltd. was formed in April 1988 by a merger of CIP Inc. and Great Lakes Forest Products Ltd. At the time, Canadian Pacific Ltd. wholly owned CIP and held 54.3% of Great Lakes, giving it 79.7% ownership of the new company.

CPFP is one of the world's largest integrated forest products companies. It manufactures a wide range of forest products including newsprint and uncoated mechanical paper, pulp, paperboard and packaging materials, white paper, tissue products, and lumber.

The company is the world's second largest producer of newsprint. In market pulp production, it ranks first in Canada and is one of the largest producers in the world.

At the end of 1989, the company's sales were C$2.9 billion, and total assets exceeded C$3 billion. About 84% of sales came from newsprint, pulp, and paperboard products.

In 1989, production of paper and paperboard products was 2,000,000 metric tons. Pulp production was 900,000 metric tons. Capital expenditures in 1989 were C$408 million. The company planned to spend C$500 million in 1990.

Construction is proceeding on schedule for CPFP's C$350-million modernization program at Thunder Bay, Ont. A 245,000-metric-tpy thermomechanical pulp mill will replace a groundwood pulp mill, and a 240,000-metric-tpy high-speed newsprint machine will replace two older machines for a net capacity gain of 60,000 tpy. Startups are set for 1990-91.

A 175,000-metric-tpy white paper machine started up at Dryden, Ont., in June 1989. And at Gold River, B.C., operations of the C$323 million joint venture newsprint mill commenced in late 1989. The new facility, with a capacity of 230,000 metric tpy, features the latest in papermaking technology.

The US$330-million joint-venture Ponderay newsprint mill at Usk, Wash., also began operating in late 1989. The mill has a capacity of 210,000 metric tpy, and the company's equity commitment is US$44 million.

In December 1989, CPFP announced a C$175-million investment to provide quality recycled-content newsprint to North American customers from the Gatineau, Que., and Thunder Bay mills. The completion of this project is scheduled for mid-1991.

In addition to the current capital expenditure program, CPFP is in the process of reviewing its operations to concentrate on the products that can be best produced and that optimize its fiber base. The objective is to market a wide range of high-quality value-added products, ensure customer satisfaction, reduce costs, and improve the ability to compete effectively in the marketplace. The forward integration into white paper at Dryden is a prime example of this strategy.

Labor negotiations in 1990 proved especially tough for CPFP, as the Canadian Paperworkers Union struck its mills in Dalhousie, N.B., and Gatineau, Que., in early September, and at Thunder Bay, Ont., in mid-October.

With 102,647 km^2 of forests, CPFP is the largest holder of timber-cutting rights in Ontario and a major forest landowner in British Columbia, Quebec, and New Brunswick.

Production facilities:

GOLD RIVER, B.C.
Pulp—710 metric tpd kraft (for market) (Gold River Newsprint Ltd. Partnership)
Newsprint—640 metric tpd (1989 startup)

DALHOUSIE, N.B.
(NBIP Forest Products Inc.)
Pulp—570 metric tpd stone groundwood; 410 metric tpd SCMP
Newsprint—940 metric tpd

DRYDEN, ONT.
Pulp—790 metric tpd bleached and unbleached kraft (360 tpd for market)
White paper—800 metric tpd

TORONTO, ONT.
(Dominion Cellulose Ltd.)
Tissue paper—230 metric tpd

GATINEAU, QUE.
Pulp—625 metric tpd stone groundwood; 450 metric tpd refiner groundwood; 375 metric tpd chemimechanical
Newsprint—1,570 metric tpd

LA TUQUE, QUE.
Pulp—1,450 metric tpd kraft (440 tpd for market)
Kraft paperboard—635 metric tpd
Solid bleached board—240 metric tpd

MATANE, QUE.
Pulp—250 metric tpd semichemical
Semichemical corrugating medium—300 metric tpd

THUNDER BAY, ONT.
Pulp—1,335 metric tpd bleached kraft (for market); 300 metric tpd high-yield sulfite; 910 metric tpd groundwood
Newsprint—1,160 metric tpd

TROIS RIVIÈRES, QUE.
Pulp—255 metric tpd sulfite; 680 metric tpd groundwood
Groundwood specialties—920 metric tpd

USK, WASH.
(Ponderay Newsprint Co.)
Newsprint—580 metric tpd

Total production capacity:

PULP	
Kraft	4,285 metric tpd
Groundwood	3,235 metric tpd
SCMP	410 metric tpd
Chemimechanical	375 metric tpd
Semichemical	250 metric tpd
Sulfite	555 metric tpd
Total	9,110 metric tpd

PAPER AND BOARD	
Newsprint	4,890 metric tpd
Groundwood specialties	920 metric tpd
Tissue paper	230 metric tpd
White paper	800 metric tpd
Unbleached board	635 metric tpd
Solid bleached board	240 metric tpd
Corrugating medium	300 metric tpd
Total	8,015 metric tpd

Canfor Corp.

2800—1055 Dunsmuir St.
P.O. Box 49420, Bentall Postal Station
Vancouver, B.C. V7X 1B5
Peter J.G. Bentley, chairman/chief executive officer

(Canadian Forest Products Ltd. is a wholly owned subsidiary. Howe Sound Pulp & Paper Ltd. is a 50%-owned affiliate.)

Net sales:	
1989	C$921,214,000
1988	1,084,200,000
1987	1,244,900,000
1986	1,046,766,000
1985	1,083,799,000
Net earnings:	
1989	C$96,351,000
1988	180,024,000
1987	102,700,000
1986	23,785,000
1985	−61,454,000
Net sales, pulp and paper:	
1989	C$396,000,000
1988	414,500,000
1987	480,700,000
1986	320,000,000
1985	254,000,000

Canfor is one of Canada's largest producers of market pulp and lumber. The company returned to profitability in 1986 after four years of heavy losses (totaling C$213 million) due to weak markets. In 1985, it bought the shares of Intercontinental Pulp that it did not already own. The company sold interests in several wood products, financial, and diversified manufacturing companies to reduce debt. Now the company can boast four years of healthy profits, totaling C$403 million.

Canfor pulp and paper sales reached C$396 million in 1989, 43% of the company's total sales.

Canfor produced 397,936 metric tons of market pulp in 1989. (This figure does not include production of Howe Sound Pulp & Paper Ltd.) Canfor also produced 93,937 metric tons of kraft paper.

Capital expenditures in 1989 totaled C$102.6 million, just short of 1988's record C$107.8 million. The company planned to spend a new high of C$140 million during 1990, C$35 million of which will go toward environmental projects. Pulp and papermaking facilities, excluding Howe Sound, will account for 60% of capital spending.

In 1988, Howe Sound, a 50:50 joint enterprise between Canfor and Oji Paper Co. Ltd. of Japan, was formed. A C$1-billion expansion and modernization project will bring its capacity for market pulp to 1,000 metric tpd by 1990. A 585-metric-tpd newsprint machine will be added by 1991.

Canfor acquired Balfour Forest Products Inc. in May 1989. And in October 1989, Canfor offered its Alberta sawmill and plywood operations for sale, as the province is placing more emphasis on pulp and paper projects than sawmilling and plywood activities.

Canfor owns or controls 853,847 hectares of timber, as well as significant timber volume that is not area based. The acquisition of Balfour increased Canfor's allowable cut in the province of British Columbia by a net of approximately 1,668,260 m^3.

Production facilities:

PORT MELLON, B.C.
(Howe Sound Pulp & Paper Ltd., formerly Howe Sound Pulp Div.)
Pulp—665 metric tpd bleached kraft (for market)

PRINCE GEORGE, B.C.
(Intercontinental Pulp)
Pulp—685 metric tpd bleached and unbleached kraft (for market)

PRINCE GEORGE, B.C.
(Prince George Pulp & Paper)
Pulp—500 metric tpd bleached and unbleached kraft (for market)
Sack paper—295 metric tpd

Total production capacity:

PULP	
Market	1,185 metric tpd (1,850 metric tpd, including Howe Sound Pulp & Paper Ltd.)
PAPER	
Sack	295 metric tpd

Caraustar Industries Inc.

Washington St., Box 115
Austell, Ga. 30001
James G. Dalton, chairman/chief executive officer

(Settsu Corp., Japan's leading producer of recycled paperboard, has a 24% minority interest in Caraustar.)

Financial data not available.

Caraustar is a privately owned holding company that has recycled paperboard mills and converting plants. It is the fourth-largest U.S. producer of recycled paperboard, with a total capacity of about 525,000 tpy. It has ten mills in the Southeast and Midwest, 16 paper tube and core plants, four setup folding carton plants, and seven wastepaper baling plants. Its most recent purchase was a 130-tpd gypsum liner mill in Camden, N.J., which it bought from USG Corp. in September 1988. This complements Caraustar's gypsum liner mills in Austell, Ga., and Cincinnati, Ohio.

Production facilities:

AUSTELL, GA.
(Austell Box Board Corp.)
Recycled paperboard—425 tpd

AUSTELL, GA.
(Sweetwater Paper Board Co.)
Recycled paperboard—375 tpd

CAMDEN, N.J.
(former USG Corp. mill)
Gypsum board—130 tpd

CHICAGO, ILL.
(Chicago Paperboard Corp.)
Recycled paperboard—200 tpd

CHARLOTTE, N.C.
(Carolina Paper Board Corp.)
Recycled paperboard—150 tpd

CINCINNATI, OHIO
(Cincinnati Paperboard Corp.)
Recycled paperboard—200 tpd

SINKING SPRING, PA.
(Reading Paper Board Corp.)
Recycled paperboard—47 tpd

TAYLORS, S.C.
(Carotell Paper Board Corp.)
Recycled paperboard—185 tpd

CHATTANOOGA, TENN.
(Chattanooga Paperboard Corp.)
Recycled paperboard—150 tpd

Total production capacity:

PAPERBOARD	1,862 tpd

Cascades Inc.

404 Marie-Victorin St.
Box 30
Kingsey Falls, Que. J0A 1B0
Bernard Lemaire, president

Net sales:	
1989	C$681,603,000
1988	588,792,000
1987	527,732,000
1986	440,130,000
1985	266,272,000
Net earnings:	
1989	C$29,887,000
1988	39,139,000
1987	34,148,000
1986	33,777,000
1985	19,443,000

Founded in 1964, Cascades has grown rapidly through a series of acquisitions in eastern Canada, the U.S., France, Belgium, and Sweden. The company is controlled by the Lemaire family of Quebec, who originally started in the wastepaper business. The company's product line includes pulp and kraft paper, toilet paper and paper towels, corrugating medium, boxboard, egg trays, roofing insulating paper, health and hygiene products, and plastics. It was the first established North American paper company to pitch its hygiene products as "environmentally friendly."

The company produced 960,000 metric tons of paper and paperboard and 130,000 metric tons of pulp in 1989. Ninety percent of Cascades' sales were derived from pulp, paper/board, and converted products.

Amounts invested to modernize existing installations and increase production capacity totaled C$80,229,000 in 1989 and should exceed C$80,000,000 in 1990.

In a 50:50 joint venture, Rexfor and Cascades acquired the closed Port-Cartier, Que., mill from ITT Rayonier Inc. in 1986. With the help of government funds, the mill was converted from sulfite pulp to bleached chemi-thermomechanical pulp (BCTMP) by 1988. It now has capacity for about 180,000 metric tpy of BCTMP.

Cascades is the only company in North America that can produce large amounts of BCTMP fluff pulp in rolls. But the fluff BCTMP market has been slow to develop, and the mill has only been running at 50% of capacity.

Some of that BCTMP fluff pulp will supply a new C$30-million, 80-metric-tpd tissue machine that started up at Cascades Ltee. division in Kingsey Falls, Que., in fourth-quarter 1989. (Cascades owns 50% of this division; Wyant Ltd. owns the other half.) Cascades is marketing the tissue as environmentally friendly because it will not contain chlorine-bleached pulp. The company will also sell diapers and sanitary napkins made from BCTMP.

In mid-1989, Cascades announced it would spend C$50 million to modernize its recycled folding boxboard mill at East Angus, Que. The first phase of the project was scheduled to be completed in fall 1990.

In spring 1989, the company acquired the assets of a manufacturer of molded pulp products located in Thorndike, near Springfield, Mass. This makes Cascades the second largest North American producer of molded pulp. The company controls 1,550,000 acres of timber in Canada.

Production facilities:

BRANTFORD, ONT.
(Cascades Dominion Inc., former Reid Dominion Packaging Ltd. mill)
Molded pulp products—egg cartons

BREAKEYVILLE, QUE.
(Désencrage Cascades Inc.)
Pulp—100 metric tpd deinked (for market)

CABANO, QUE.
(Papier Cascades [Cabano] Inc.)
Pulp—250 metric tpd semichemical
Corrugating medium—325 metric tpd

DRUMMONDVILLE, QUE.
(Cascades P.S.H. Inc.)
Sanitary napkins—adult diapers

EAST ANGUS, QUE.
(Cascades [East-Angus] Inc.)
Pulp—180 metric tpd unbleached kraft; 109 metric tpd semichemical
Kraft wrapping paper—220 metric tpd
Folding boxboard—125 metric tpd

JOLIETTE, QUE.
(Cascades [Joliette] Inc.)
Sheathing, indenting paper—64 metric tpd

JONQUIÈRE, QUE.
(Cascades [Jonquière] Inc.)
Pulp—200 metric tpd bleached and unbleached kraft (60 tpd for market); 100 metric tpd thermomechanical
Boxboard—225 metric tpd

KINGSEY-FALLS, QUE.
(Cascades Paper Inc.)
Corrugating medium—100 metric tpd
Molded pulp products—32 metric tpd

KINGSEY-FALLS, QUE.
(Les Industries Cascades Ltee.)
Tissue—120 metric tpd
Toweling—80 metric tpd

KINGSEY-FALLS, QUE.
(Papier Kingsey-Falls)
Chipboard-linerboard—160 metric tpd

LOUISEVILLE, QUE.
(Matériaux Cascades Inc.)
Construction board

PORT-CARTIER, QUE.
(Cascades [Port-Cartier] Inc.)
Pulp—500 metric tpd bleached chemi-thermomechanical

NIAGARA FALLS, N.Y.
(Cascades Niagara Falls Inc.—former Nitec Paper Corp. mill)
Corrugating medium—250 short tpd (226 metric)

ROCKINGHAM, N.C.
(Cascades Industries Inc.)
Tissue—60 short tpd (54 metric)

ROCKINGHAM, N.C.
(Cascades Moulded Pulp Inc.)
Molded pulp products, egg cartons

THORNDIKE, MASS.
(Cascades Diamond Inc.)
Molded pulp products

Total production capacity:

PULP	
Kraft	380 metric tpd
Semichemical	359 metric tpd
TMP, BCTMP	600 metric tpd
Deinked	100 metric tpd
Total	1,439 metric tpd
PAPER AND BOARD	
Tissue/toweling	254 metric tpd
Kraft packaging	220 metric tpd
Corrugating medium	651 metric tpd
Boxboard	350 metric tpd
Industrial paper/board	224 metric tpd
Total	1,699 metric tpd

Champion International Corp.

One Champion Plaza
Stamford, Conn. 06921
Andrew C. Sigler, chairman/chief executive officer

(Champion owns 84.6% of Weldwood of Canada Ltd., which in turn owns 50% of Cariboo Pulp & Paper Co.; Daishowa-Marubeni International Ltd. owns the other 50%.)

Net sales:	
1989	$5,163,218,000
1988	5,128,513,000
1987	4,614,723,000
1986	4,387,623,000
1985	5,769,759,000
Net income:	
1989	$432,421,000
1988	456,445,000
1987*	382,012,000
1986	200,832,000
1985**	163,139,000

*Includes $88.7-million net gain from sale of assets.

**Excludes $5-million gain from St. Regis acquisition.

Champion International is emphasizing growth in the printing/writing grades following the sale of all but one of its unbleached kraft packaging mills. Its merger with St. Regis Paper Co. focused Champion on being primarily a pulp and paper company and combined Champion's strength in coated and uncoated free-sheet grades with St. Regis' strength in uncoated groundwood grades, lightweight coated publication papers, and newsprint.

Since the merger, however, several mills have been sold: Battle Creek, Mich., and St. Paul, Minn., to Waldorf Corp.; Ontonagon, Mich., Missoula, Mont., and York, Pa., to Stone Container Corp.; Pasadena, Texas, and Tacoma, Wash., to Simpson Paper Co.; Little Falls, Minn., to Carlyle Investment Corp.; and Columbus, Ohio, to Du Pont Co.'s Industrial Imaging Systems Div.

In early 1988, Weldwood of Canada Ltd. got approval from shareholders to purchase Champion's St. Regis Paper Co. (Canada) Ltd., which includes Champion Forest Products (Alberta) Ltd. (of which the Hinton, Alta., market pulp mill is a part) and St. Regis Resources Ltd. (oil and gas). In exchange, Champion's share in Weldwood was boosted from 71.8% to 84.6%.

Net sales of paper in 1989 were $4.0 billion, constituting 78% of total company sales. Printing/writing papers accounted for 49% of paper sales, lightweight publication papers 17%, and newsprint 9%.

Champion's paper division produced 3,338,625 short tons of paper and board in 1989. Champion also produced 3,103,984 tons of pulp, while Weldwood of Canada produced 321,000 tons. U.S. packaging operations produced 466,600 tons of paper/paperboard and 456,000 tons of pulp.

Other 1989 production figures: 279,000 short tons of coated paper, 1,077,000 tons of uncoated paper, 607,000 tons of publication papers, and 822,000 tons of newsprint.

The company devoted $902.9 million to capital expenditures in 1989, and it expected to spend close to $1 billion in 1990.

A C$360-million pulp expansion project at Weldwood's Hinton, Alta., mill was scheduled for completion in second-quarter 1990. The project was expected to double the mills annual capacity to 422,000 tpy of bleached softwood pulp. In August 1988, Champion began construction of a 265,000-tpy coated free-sheet paper machine at Quinnesec, Mich., which will use about half the mill's pulp output. The addition was expected to cost $350 million, and startup was scheduled for summer 1990.

At its Pensacola, Fla., mill in 1989, Champion completed a $32-million conversion of the No. 3 machine from kraft paper to uncoated free-sheet, adding 107,000 tpy of white paper to the mill's capacity.

A $560-million series of projects is planned for the printing/writing papers mill at Courtland, Ala. Pulp capacity will increase by 247,000 tpy, half of which will be used by company mills or sold as market pulp. Paper capacity at the mill will increase by 139,000 tpy, or 22%. Started in late 1988, the project should be completed by 1992.

Implementation of a $250-million restructuring project at the company's Canton, N.C., pulp mill finally got the go-ahead in April 1990. The project is expected to take three years to complete.

In early 1990, the Sheldon, Texas, newsprint mill was in the preliminary engineering design phase for a deinking facility that will enable the company to use recycled fiber in the manufacture of newsprint. The $230-million project, which is scheduled to be completed in 1993, includes a conversion to twin-wire forming and an optimization program.

Champion owns or controls 6,444 acres of timberland in the U.S. In Canada, the company has cutting rights on 2,488,000 acres in Alberta, and Weldwood owns 42,000 acres and holds a pulpwood harvesting license on 3.9 million acres.

Production facilities:

COURTLAND, ALA.
(Paper Div.)
Pulp—1,525 tpd kraft
Uncoated and coated printing/writing and converting paper—1,760 tpd

PENSACOLA (Cantonment), FLA.
(Printing & Writing Div.)
Pulp—1,300 tpd bleached kraft
Uncoated free-sheet paper—1,054 tpd

BUCKSPORT, MAINE
(Publication Papers)
Pulp—299 tpd groundwood; 150 tpd thermomechanical
Publication papers—1,140 tpd

QUINNESEC, MICH.
Pulp—750 bleached hardwood kraft (for market)

SARTELL, MINN.
(Publication Papers)
Pulp—424 tpd thermomechanical
Publication papers—810 tpd (546 tpd coated, 264 tpd uncoated)

DEFERIET, N.Y.
(Publication Papers)
Pulp—331 tpd groundwood
Publication papers—614 tpd

CANTON, N.C.
(Paper Div.)
Pulp—1,445 tpd bleached kraft
Uncoated printing/writing and converting paper—895 tpd
Bleached paperboard—715 tpd

ROANOKE RAPIDS, N.C.
(Packaging Div.)
Pulp—1,300 tpd unbleached kraft
Unbleached kraft paper—525 tpd
Unbleached linerboard—750 tpd

HAMILTON, OHIO
(Paper Div.)
Uncoated and coated printing/writing and converting paper—523 tpd

HOUSTON, TEXAS
(Newsprint Div., Sheldon mill)
Pulp—650 tpd kraft (unbleached 300 tpd, bleached 350 tpd); 800 tpd groundwood; 400 tpd thermomechanical
Newsprint—1,220 tpd

LUFKIN, TEXAS
(Newsprint Div., Lufkin Mill)
Pulp—400 tpd unbleached kraft (360 tpd semibleached); 830 tpd groundwood
Newsprint—980 tpd
Directory paper—150 tpd

QUESNEL, B.C.
(Cariboo Pulp & Paper Co.—See Daishowa America Co. and Weldwood of Canada Ltd.)

Total production capacity:

PULP (short tons)	
Kraft	7,370 tpd
Groundwood	2,260 tpd
TMP	974 tpd
Total	10,604 tpd
PAPER (short tons)	
Newsprint	2,200 tpd
Printing/writing and converting	3,178 tpd
Publication papers	2,564
Uncoated free-sheet	1,054 tpd
Directory	150 tpd
Kraft	525 tpd
Total	9,663 tpd
PAPERBOARD (short tons)	
Bleached	715 tpd
Linerboard	750 tpd
Total	1,465 tpd
TOTAL PAPER/BOARD	11,130 tpd

Chesapeake Corp.

1021 E. Cary Street, Box 2350
Richmond, Va. 23218-2350
J. Carter Fox, president/chief executive officer

Net sales:	
1989	$813,100,000
1988	711,300,000
1987	675,713,000
1986	599,770,000
1985	449,500,000
Net income:	
1989	$47,600,000
1988	51,500,000
1987	30,153,000
1986	13,738,000
1985	15,694,000

From only one mill at West Point, Va., Chesapeake underwent a dramatic change in 1985 with its $210-million purchase of Wisconsin Tissue Mills Inc. and Plainwell Paper Co. from Philip Morris Inc. This extended its original product line of linerboard, kraft paper, and hardwood market pulp to include commercial/industrial tissue and coated and uncoated specialty and premium printing papers. In late 1987, Chesapeake sold Plainwell to Simpson Paper Co., eliminating printing and special industrial papers from its line. The company currently focuses on kraft products that emphasize white-top specialty products and products using recycled paper, as well as tissue products, packaging, and treated wood. Chesapeake has been described as having grown from "an old-line box maker...to a high-profit niche player."

Paper sales in 1989 were $456.0 million, 56% of total company sales. Chesapeake shipped 627,000 tons of kraft products, 119,000 tons of tissue products, and 83,000 tons of printing paper.

Capital expenditures in 1989 were $139.5 million, almost double the amount spent in 1988. The company expected to spend $140 million in 1990.

In 1988, Chesapeake began a $160-million expansion at Wisconsin Tissue Mills with expenditures for distribution facilities and converting equipment. An 80,000-tpy tissue machine was due to start up during June 1990, raising mill capacity to about 200,000 tpy. Once this expansion is complete, the company will be able to begin work on a new recovery boiler at its West Point, Va., kraft products mill.

The recovery boiler and related equipment, which is expected to cost about $100 million, will allow Chesapeake to increase its emphasis on white-top paperboard products at West Point.

Chesapeake owns 356,000 acres of timberland.

Production facilities:

WEST POINT, VA.
Pulp—1,400 tpd softwood and hardwood kraft (450 tpd bleached for market)
Paper—320 tpd
Paperboard—1,430 tpd

MENASHA, WIS.
(Wisconsin Tissue Mills Inc.)
Pulp—deinking
Paper—300 tpd tissue

Total production capacity:

PULP	1,400 tpd
PAPER AND BOARD	2,050 tpd

Consolidated Papers Inc.

Box 8050
Wisconsin Rapids, Wis. 54495-8050
George W. Mead, chairman/chief executive officer

Net sales:	
1989	$952,521,000
1988	896,804,000
1987	742,835,000
1986	653,040,000
1985	715,744,000
Net income:	
1989	$167,919,000
1988	$149,883,000
1987	95,798,000
1986	87,542,000
1985	106,881,000

Consolidated Papers is a leading producer of coated free-sheet and lightweight coated groundwood grades. Key to Consolidated's strategy are ongoing capital expenditure projects to improve productivity and quality at its five Wisconsin mills. This has enabled the company to retain its reputation as a low-cost, high-quality producer.

Total paper and paperboard shipments in 1989 were 970,351 short tons. Enamel papers accounted for 840,136 tons; specialty papers, 56,254 tons; and paperboard, 5,790 tons. The Kraft Div. (Wisconsin Rapids, Wis.) supplied 257,779 tons of chemical pulp in 1989. Total pulp production was 439,675 tons.

Capital spending in 1989 was $149.9 million, and $340.0 million was authorized for 1990.

In March 1989, the company broke ground for No. 34, a $135-million lightweight coated specialty paper machine at its Stevens Point, Wis., Div. The 59,000-tpy machine is on schedule for late-1990 completion and will double mill capacity. In October 1989, the board of directors approved a $495-million enamel paper machine expansion for the Wisconsin Rapids Div. No. 16 will produce up to 600 roll tpd of coated free-sheet printing paper. Startup is scheduled for late 1991.

Startup of these new machines will increase the company's dependency on market chemical pulp. To lessen this dependency and return to its historical level of about 75% internally produced chemical pulp, the company is conducting a preliminary feasibility study for a major chemical pulp mill expansion.

Consolidated owns 671,131 acres of timberland in the U.S. and Canada.

Production facilities:

STEVENS POINT, WIS.
(Stevens Point Div.)
Specialty paper—166 tpd

STEVENS POINT, WIS.
(Wisconsin River Div.)
Pulp—272 tpd groundwood
Book paper—629 tpd

WISCONSIN RAPIDS, WIS.
(Wisconsin Rapids Div.)
Enamel paper—701 tpd
Paperboard—104 tpd
WISCONSIN RAPIDS, WIS.
(Biron Div.)
Pulp—553 tpd groundwood
Book paper—1,090 tpd

WISCONSIN RAPIDS, WIS.
(Kraft Div.)
Pulp—944 tpd kraft

Total production capacity:

PULP	
Groundwood	825 tpd
Kraft	944 tpd
Total	1,769 tpd
PAPER & BOARD	
Book paper	1,719 tpd
Enamel paper	701 tpd
Specialty paper	166 tpd
Paperboard	104 tpd
Total	2,690 tpd

Daishowa International

(Subsidiary of Daishowa Paper Manufacturing Co. Ltd., Japan)
Yomoji Saito, president

Financial data not available.

Daishowa America Co. Ltd.
(Subsidiary of Daishowa International)
1001 4th Ave. Plaza, Suite 3103
Seattle, Wash. 98154
Seiichi Taniguchi, executive vice president

Daishowa Paper Manufacturing Co. Ltd. is the second-largest paper and board producer in Japan. It has been assiduously acquiring assets in North America, often in the form of joint-venture partnerships.

In November 1987, James River Corp. announced it would sell its Port Angeles, Wash., groundwood papers mill (acquired with the purchase of Crown Zellerbach Corp. mills) to Daishowa America. In spring 1988, Daishowa conducted a feasibility study for addition of two new paper machines at Port Angeles—one for newsprint and the other for uncoated groundwood directory paper. In mid-1989, however, the company said it would postpone the two-phase expansion. The proposed project includes installation of a 224,000-metric-tpy newsprint machine by 1991 or 1992, followed by a 150,000-tpy directory paper machine by 1994. The mill currently produces 130,000 tpy of directory paper. The cost of the project is estimated to be $560 million.

Daishowa has completed a $22-million project to rebuild No. 3 directory paper machine at Port Angeles. The 216-tpd groundwood machine, which started up in July 1989, was upgraded to match the paper quality of No. 2 machine, which has capacity for about 135 tpd. The rebuild was expected to add 18 tpd to the mill's capacity. Daishowa planned to spend $3 million in 1990 to upgrade No. 2.

In August 1989, Daishowa America announced that, in a joint venture with Trans-Rim Enterprises Ltd., it plans to build a 350,000-tpy recycled linerboard mill on land leased from the Port of Stockton, Calif. The $200-million mill will produce mottled white and white-top linerboard as well as standard linerboard grades and some corrugating medium. The negotiations were close to finalization in January 1990, but no firm startup date had been established. The mill was expected to start up in early 1992.

In July 1990, the company shelved plans to build an unbleached kraft market pulp mill near Coos Bay, Ore. It had been studying the project for two years. Daishowa also seems to be interested in building a $25-million-plus deinking plant in Port Angeles, Wash. The 170-tpd operation would provide wastepaper-based pulp for production of the mill's telephone directory paper.

Daishowa Canada Co. Ltd.
(Subsidiary of Daishowa International)
Box 11595, 650 W. Georgia St.
Vancouver, B.C. V6B 4N8
Koichi Kitatawa, vice president/general manager

Daishowa-Marubeni International Ltd. owns half of Cariboo Pulp & Paper Co.'s 260,000-metric-tpy bleached kraft pulp mill. (Weldwood of Canada Ltd. owns the other half.) A C$60-million modernization completed at this mill in June 1989 will eventually lift pulp capacity by 55,000 tpy to 315,000 tpy. The company currently has no plans to integrate the mill.

Daishowa Canada owns half of Quesnel River Pulp Co.'s thermomechanical and chemi-thermomechanical pulp mill, which was expanded and modernized in an $80-million project completed in late 1988. This project included the addition of a third pulp line with capacity for about 300 a.d. metric tpd of pulp.

Construction by Daishowa Canada of a 340,000-metric-tpy bleached kraft pulp mill in northern Alberta was given the go-ahead in early 1988. The C$500-million mill, near Peace River, Alta., gained provincial approval to begin operations in summer 1990.

Production facilities:

PORT ANGELES, WASH. (100% ownership)
(Daishowa America Co. Ltd.)
Pulp—285 metric tpd stone groundwood, thermomechanical
Directory paper—390 metric tpd

QUESNEL, B.C. (25% ownership)
(Cariboo Pulp & Paper Co.)
Pulp—800 metric tpd bleached kraft
(Daishowa-Marubeni's share: 400 metric tpd)

QUESNEL, B.C. (50% ownership)
(Quesnel River Pulp Co.)
Pulp—900 metric tpd thermomechanical and BCTMP
(Daishowa Canada's share: 450 metric tpd)

PEACE RIVER, ALTA. (100% ownership)
(Daishowa Canada Co. Ltd.)
Pulp—958 metric tpd bleached hardwood kraft
*Mill started up inJuly 1991.

Total production capacity:
(including Peace River mill)

PULP	
Kraft	1,385 metric tpd
Groundwood/TMP	735 metric tpd
Sulfite	92 metric tpd
Total	1,227 metric tpd
PAPER	1,663 metric tpd

Daishowa Forest Products Ltd.
(formerly Reed Paper Inc.)
207 Queen's Quay West, Suite 880
Toronto, Ont. M5J 1A7
Koichi Kitagawa, president/chief executive officer

(Beneficially owned 100% by Daishowa Paper Manufacturing Co. Ltd. of Japan. Financial statistics were not available for this edition.)

In June 1988, Reed International plc announced it would sell its North American paper group to Daishowa Paper Manufacturing, and the operations became Daishowa Forest Products. The primary asset in the deal was a 417,000-metric-tpy newsprint mill in Quebec City, Que. The mill also makes 35,000 tpy of boxboard and 20,000 tpy of sulfite pulp sold on the market. Daishowa also got a flexible packaging business in Winnipeg, Man.; pigment manufacturing facilities in Toronto, Ont.; and lignin sulfonate plants in Quebec City and Rothschild, Wis. Daishowa Forest Products produces mainly newsprint, along with market pulp, paperboard, lumber, chemicals, and packaging. Seventy-eight percent of company sales come from pulp, paper, and paperboard products.

Daishowa Forest Products started up a new thermomechanical pulp plant at the Quebec City mill, which was designed to replace part of the groundwood and sulfite pulp furnish used to produce newsprint, the mill's primary output. The project allowed the mill to virtually eliminate kraft pulp from the newsprint sheet while improving strength and brightness. The mill has four newsprint machines that produce about 1,200 tpd, one cylinderboard machine, and two pulp drying machines. The company is considering adding a new paper machine at the facility.

In February 1990, Daishowa Forest Products announced plans to proceed with the modernization and expansion of its recycled cylinderboard machine at the Quebec City mill. The C$27-million project is expected to include the replacement of the Inglis seven-cylinder machine's forming equipment and upgrading of the press section. The project is scheduled for completion in the first quarter of 1991. The company also announced plans to add a 300-metric-tpd deinking plant at the mill, with construction starting in April 1991, and startup slated for first-quarter 1992.

Production facilities:

QUEBEC CITY, QUE.
Pulp—800 metric tpd groundwood; 400 metric tpd sulfite (60 tpd for market)
Newsprint—1,290 metric tpd
Paperboard—100 metric tpd

Total production capacity:

PULP	
Total	1,200 metric tpd
PAPER AND BOARD	
Total	1,390 metric tpd

Domtar Inc.

395 de Maisonneuve Blvd. W.
Montreal, Que. H3A 1L6
James H. Smith, chairman/chief executive officer

(Forty-four percent of Domtar is jointly owned by Caisse de Dépôt du Placement du Québec, and Soc. Générale de Financement du Québec.)

Net sales:	
1989	C$2,515,000,000
1988	2,703,000,000
1987	2,568,000,000
1986	2,327,000,000
1985	2,130,000,000
Net income:	
1989	C$33,000,000
1988	111,000,000
1987	161,000,000
1986	145,000,000
1985	110,000,000

Domtar is a producer of pulp, paper, lumber, packaging, and construction materials. Pulp, paper, lumber, and packaging account for about 71% of its total sales. In 1989, Domtar announced its intention to divest itself of its Chemicals Group and its gas and oil businesses. These actions are consistent with the company's strategic thrust to focus on forest products, packaging, and construction materials industries. Toward the end of 1990, the company was cutting staff due to poor financial performance.

During the past three years, Domtar's Pulp & Paper Products Group has accounted for about 51% of consolidated sales, while its Packaging Group generated about 19% of these sales during the same period.

Domtar is Canada's largest manufacturer of fine papers, with sales in 1989 of C$786 million. Newsprint and groundwood specialties sales were C$357 million; market pulp and lumber sales were $157 million, and packaging products sales were $494 million.

In 1989, the company produced 527,000 metric tons of fine and specialty papers, 374,000 tons of newsprint, 177,000 tons of market pulp, and 421,000 tons of containerboard.

Capital spending in 1989 reached C$395 million, 52% of which was for pulp and papermaking facilities. A $1-billion rehabilitation is still under way at the fine papers complex at Windsor, Que. Two new paper machines with a combined capacity of 350,000 short tpy and a 330,000-tpy integrated pulp mill will be added, bringing Domtar's total fine papers capacity to 740,000 tpy. The first machine came online in July 1988, and the second started up in January 1989.

In 1989, Domtar strengthened its fiber supply by acquiring three sawmills in north western Quebec and undertaking a major program to further improve environmental pollution controls at the kraft pulp mill at Lebel-sur-Quévillon, Quebec.

Domtar owns 995,000 acres of timberland in Canada and the U.S., and it has cutting rights on another 7.7 million acres in Canada. About half of the company's 2.8 million metric tons of pulp requirements came from these lands in 1989.

Production facilities:

Pulp & Paper Products Group:

CORNWALL, ONT.
(Fine Papers Div.)
Pulp—333 metric tpd kraft
Fine paper—756 metric tpd

ST. CATHARINES, ONT.
(Fine Papers Div.)
Fine paper—180 metric tpd

BEAUHARNOIS, QUE.
(Fine Papers Div.)
Fine paper—180 metric tpd

DOLBEAU, QUE.
(Newsprint & Kraft Pulp Div.)
Pulp—600 metric tpd chemi-thermomechanical
Newsprint—500 metric tpd

DONNACONA, QUE.
(Newsprint & Kraft Pulp Div.)
Pulp—500 metric tpd thermomechanical
Newsprint and groundwood printing paper—500 metric tpd

LEBEL-sur-QUÉVILLON, QUE.
(Newsprint & Kraft Pulp Div.)
Pulp—720 metric tpd kraft (for market)

WINDSOR, QUE.
(Fine Papers Div.)
Pulp—850 metric tpd kraft
Fine paper—1,000 metric tpd

Packaging Group:

MISSISSAUGA, ONT.
Linerboard—256 metric tpd

RED ROCK, ONT.
Pulp—773 metric tpd kraft; 166 tpd groundwood
Linerboard—651 metric tpd
Newsprint—202 metric tpd

TRENTON, ONT.
Pulp—136 metric tpd semichemical
Corrugating medium—312 metric tpd

Construction Materials,
Gypsum Products:

SAN LEANDRO, CALIF.
(Domtar Gypsum Inc.)
Chipboard, gypsum linerboard—150 short tpd (136 metric)

VERNON,CALIF.
(Domtar Gypsum Inc.; formerly Genstar Gypsum Products Co. mill)
Gypsum paper—150 short tpd (136 metric)

LOCKPORT, N.Y.
(Upson Products Div.
Gypsum linerboard—170 short tpd (154 metric)

Total production capacity:

PULP	
Kraft	2,453 metric tpd
Groundwood	166 metric tpd
Semichemical	136 metric tpd
TMP	500 metric tpd
CTMP	600 metric tpd
Total	3,855 metric tpd

PAPER AND BOARD	
Newsprint, groundwood printing	1,202 metric tpd
Fine paper	1,443 metric tpd
Linerboard	907 metric tpd
Corrugating medium	312 metric tpd
Gypsum paper/board	426 metric tpd
Total	4,290 metric tpd

Donohue Inc.

801 chemin Saint-Louis
Quebec City, Que. G1S 4W3
Charles-Albert Poissant, chairman/chief executive officer

(In July 1987, the Quebec government, through its Dofor Inc. subsidiary, completed the sale of its 55.25% share in Donohue to a new firm, Mircor Inc., owned by Quebecor Inc. of Montreal, Que., and Maxwell Communication Corp. plc of London, U.K., which have 51% and 49% of the shares, respectively, and thus 29% and 27% of Donohue.

(Donohue owns 55% of Donohue St-Félicien Inc.; Fletcher Challenge Canada Ltd. owns 45%. Donohue owns 58.1% of Donohue Normick Inc.; Normick Perron Inc. owns 41.9%. At the three-machine mill at Clermont, Que., Donohue owns 51% of Donohue Malbaie Inc.; the New York Times Co. owns 49%. In addition, Donohue has two other paper machines at this mill.)

Net sales:	
1989	C$641,472,000
1988	648,337,000
1987	510,054,000
1986	475,610,000
1985	424,971,000
Net income:	
1989	C$44,250,000
1988	68,691,000
1987	44,247,000
1986	24,473,000
1985	20,673,000

Donohue Inc. has been a heavy capital spender during the past decade with its involvement in construction of the C$280-million pulp mill in 1978 (Donohue St-Félicien), a greenfield newsprint mill in 1982 (Donohue Normick Inc.), and a new thermomechanical pulping system and newsprint machine at its existing newsprint mill. As a result, Donohue has some of the most modern, large-scale mills in the Canadian industry.

Market pulp output in 1989 was 303,489 metric tons, and newsprint production was 467,983 metric tons.

Capital expenditures in 1989 of C$37.3 million went toward maintaining and improving Donohue's facilities. Of this amount, C$10.9 million went to newsprint and C$5.2 million went to market pulp.

In July 1988, Donohue Malbaie inaugurated a C$139-million, 180,000-metric-tpy newsprint machine at Clermont.

Engineering and construction of the new C$289.5-million, 190,000-metric-tpy bleached chemi-thermomechanical pulp mill at Matane, Que., is on schedule. The mill is being built and and will be managed by Donohue Matane Inc., a company that is held 50% by Donohue and 50% by Rexfor, a Quebec Crown corporation. The mill was scheduled to be online in November 1990.

Donohue has decided to reactivate the study set aside regarding a deinking mill. Two locations are being looked into for this 80,000-metric-ton, C$65-million facility.

Production facilities:

AMOS, QUE.
(Donohue Normick Inc.)
Pulp—535 metric tpd thermomechanical
Newsprint—470 metric tpd

CLERMONT, QUE.
Pulp—1,100 metric tpd thermomechanical; 150 metric tpd sulfite; 615 tpd groundwood
Newsprint—715 metric tpd

MATANE, QUE.
(Donohue Matane Inc. proposed mill)
Pulp—535 metric tpd bleached chemi-thermomechanical

ST-FÉLICIEN, QUE.
(Donohue St-Félicien)
Pulp—850 metric tpd bleached kraft for market (Donohue's share—468 tpd)

Total production capacity:

PULP	
Sulfite	150 metric tpd
Groundwood	615 metric tpd
TMP	1,635 metric tpd
Kraft	468 metric tpd
Total*	2,868 metric tpd

*Does not include Matane.

PAPER	
Newsprint	1,185 metric tpd

Eddy Paper Co. Ltd.

1335 Carling Ave.
Box 3521, Station C
Ottawa, Ont. K1Y 4L5
E.F. Boswell, president/chief executive officer

(A wholly owned subsidiary of George Weston Ltd., Eddy Paper in turn owns E.B. Eddy Forest Products Ltd.)

Net sales, Forest Products:	
1989	C$634,863,000
1988	788,319,000
1987	659,165,000
1986	584,422,000
1985	526,000,000
Operating income:	
1989	n.a.
1988	93,000,000
1987	68,000,000
1986	56,000,000
1985	36,000,000

Eddy Paper Co. Ltd. is a producer of fine paper, tissue, specialty papers, and market pulp. It transfers market pulp from its 340,000-metric-tpy Espanola, Ont., mill to its nonintegrated paper mills at Ottawa, Ont.; Hull, Que.; and Port Huron, Mich. About 225,000 tons of market pulp are sold on the outside.

About 90% of total sales are derived from the pulp and paper sector. In 1989, Eddy produced 272,513 short tons of paper and 368,194 metric tons of pulp.

Capital expenditures in 1989 were C$57 million, and the company expected to spend $62 million in 1990.

In March 1989, the White Swan Div. at Hull, Que., was sold to Scott Paper Ltd. An agreement to sell Eastern Fine Paper Inc. to Precor Corp. was completed in early April. Net proceeds in the C$100-million range were redirected to existing operations and new investments.

Eddy cuts timber on 6,600 mi^2 of Crown woodlands in Canada.

Production facilities:

ESPANOLA, ONT.
(E.B. Eddy Forest Products)
Pulp—971 metric tpd kraft (627 tpd for market)
Fine and specialty paper—154 metric tpd

OTTAWA, ONT.
(E.B. Eddy Forest Products)
Fine and specialty paper—177 metric tpd

HULL, QUE.
(E.B. Eddy Forest Products)
Fine and specialty paper—260 metric tpd

PORT HURON, MICH.
(E.B. Eddy Paper Inc.)
Specialty paper—235 short tpd (213 metric)

Total production capacity:

PULP	971 metric tpd
PAPER Fine/specialty	804 metric tpd

Eurocan Pulp & Paper Co.

Box 1400
Kitimat, B.C. V8C 2H1
Kari Suopanki, president/chief executive officer

(Eurocan is a joint venture between Enso Forest Products Ltd. [division of Enso-Gutzeit Oy, Finland] and West Fraser Timber Co. Ltd.)

Net sales (C$):	
1989	Not available
1988	Not available
1987	C$318,000,000
1986	283,000,000
1985	236,000,000
1984	210,000,000

Since starting up in 1971 under the ownership of three Finnish companies, this interior British Columbian mill has had an uneven financial performance due to market fluctuations for its principal products—linerboard and kraft paper. The company has undergone several ownership changes, the most recent when West Fraser bought 50% control in 1981-84.

Eurocan completed a C$126-million project to raise linerboard capacity by 105,000 metric tpy and increase pulping capacity by an equivalent amount. The project included a new chemimechanical pulp line, a new stock preparation system, and a linerboard machine rebuild.

In June 1989, the wet end rebuild of the linerboard machine was completed. The mill planned to increase linerboard production from 800 to 1,000 tpd by year-end 1989.

Production facilities:

KITIMAT, B.C.
Pulp—950 metric tpd kraft
Linerboard and kraft paper—1,210 metric tpd

Total production capacity:

PULP	950 metric tpd
PAPER AND BOARD	1,210 metric tpd

Federal Paper Board Co. Inc.

75 Chestnut Ridge Rd.
Montvale, N.J. 07645
John R. Kennedy Jr., president/chief executive officer

Net sales:	
1989	$1,310,143,000
1988	1,116,941,000
1987	1,025,727,000
1986	948,560,000
1985	783,927,000
Net income:	
1989	$205,480,000
1988	143,000,000
1987*	65,763,000
1986*	18,410,000
1985	11,196,000

*After extraordinary charge of $8,217,000 in 1987 and $15,125,000 in 1986.

Federal has three segments: Paper, Paperboard, and Pulp (bleached paperboard and pulp, recycled paperboard, uncoated paper); Wood Products (sheeting plants, woodlands, and lumber); and Converting Operations (packaging and printing and cup operations).

Total sales in 1989 of paper, paperboard, and pulp were $974.4 million. Net sales to unaffiliated customers were $657.4 million for recycled and bleached paperboard and $317.0 million for pulp.

In 1989, Federal produced 800,953 tons of bleached paperboard, 533,226 tons of market pulp, and 168,675 tons of recycled paperboard.

Total capital expenditures in 1989 were $399.7 million, $357.8 million of which went toward paper, paperboard, and pulp operations. Federal expected to spend a total of $415 million in 1990.

The company completed Phase I and is in Phase II of its $530-million capital program at the Augusta, Ga., bleached paperboard mill. Phase II includes a paperboard capacity expansion to 1,860 tpd and rebuilds of two of the mill's three machines. Startup is expected for 1990. Phase III will include installation of a fourth paperboard machine, bringing mill capacity to 2,500 tpd. Completion is scheduled for 1992.

Capacity was also increased at the Sprague, Conn., recycled paperboard mill in the first quarter of 1990.

In April 1989, Federal acquired Thomas Tait & Sons Ltd., Inverurie, Scotland, a significant producer of uncoated paper, marketed in the U.K. and on the European continent.

The company also acquired Imperial Cup Corp. in October 1989, providing an entry into a new and growing market and an outlet for bleached paperboard produced at Federal's own mills. In August 1990, Federal said it would buy Continental Bondware, a major producer of paper cups and disposable food service products.

Federal owns 558,200 acres of timberland in the U.S., and it leases an additional 131,600 acres.

Production facilities:

VERSAILLES, CONN.
(Sprague Div.)
Recycled board—600 tpd

AUGUSTA, GA.
Pulp—1,374 tpd bleached kraft (110 tpd for market)
Bleached paperboard—1,370 tpd

RIEGELWOOD, N.C.
Pulp—2,146 tpd bleached kraft (1,258 tpd for market)
Bleached paperboard—910 tpd

Total production capacity:

PULP	2,204 tpd
PAPERBOARD	
Bleached paperboard	2,280 tpd
Recycled paperboard	600 tpd
Total	2,880 tpd

Fletcher Challenge Canada Ltd.

700 West Georgia St.
Box 10058, Pacific Centre
Vancouver, B.C. V7Y 1J7
Ian Donald, president/chief executive officer

(FCC owns 100% of Blandin Paper Co., 45% of Donohue St-Felicien Inc., and 50% of Finlay Forest Industries Ltd. In late 1989, FCC sold its 22.7% stake in Western Forest Products Ltd., the parent of Western Pulp Ltd. Partnership of British Columbia, to Doman Industries Inc.)

Net sales:	
1989	C$1,402,793,000
1988	1,471,532,000
1987	1,400,427,000
1986	1,100,900,000
1985	1,140,000,000
Net earnings:	
1989	C$96,207,000
1988	182,200,000
1987	140,200,000
1986	40,200,000
1985	30,100,000

In September 1988, shareholders of British Columbia Forest Products Ltd. approved a plan by parent company Fletcher Challenge Ltd. of New Zealand to jointly operate its Canadian holdings, creating a new company called Fletcher Challenge Canada Ltd., based in Vancouver, B.C. FCC accomplished this without having to buy out BCFP's minority shareholders.

Under the plan, BCFP and Crown Forest Industries Ltd. are run by the new company, essentially merging the two operations, although FC owns just 69% of BCFP. To accomplish this, FC awarded BCFP a contract to manage its wholly owned CFI operations for a fee. The merger enabled FCC to combine functions such as marketing, accounting, and administration and to concentrate on expansions and modernizations. Capital spending in 1989 amounted to C$465 million, up from C$306 million in 1988. Spending in 1990 was expected to decrease to C$279 million.

Production in 1989 for paper and paperboard reached 722,000 metric tons. Pulp production was 404,000 metric tons. Fifty-eight percent of the company's sales are derived from pulp, paper/board, and converted products.

In March 1989, Finlay Forest Industries Ltd. started up a new newsprint machine at its mill in Mackenzie, B.C. This is the first newsprint machine ever to be constructed in the British Columbia interior. The new machine has a rated capacity of 212,000 metric tpy, but it can make only 180,000 metric tpy because of limited pulp capacity.

A C$50-million environmental program for the company's Mackenzie pulp mill was announced in May 1989. In July, a C$70-million program to provide secondary treatment to mill effluent at Crofton commenced in addition to the current upgrading and expansion of the kraft pulp mill. This modernization, due for completion in 1991, will increase capacity by 75,000 metric tpy.

In October 1989, Blandin Paper Co. started up a new lightweight coated groundwood paper machine with capacity for 254,000 short tpy. The $350-million project increased mill capacity by 67% from 300,000 tpy to 500,000 tpy of paper.

Also in October, the company completed the sale of its investment in Western Forest Products Limited.

Production facilities:

CAMPBELL RIVER, B.C.
(Elk Falls Mill of Crown Forest Industries)
Pulp—1,035 metric tpd kraft (510 tpd bleached for market); 1,250 tpd thermomechanical
Newsprint—1,280 metric tpd
Kraft specialties and linerboard—240 metric tpd

CROFTON, B.C.
(Crofton Pulp & Paper Div.)
Pulp—1,000 metric tpd kraft (750 tpd for market); 940 metric tpd mechanical
Newsprint and specialty paper—1,300 metric tpd

MACKENZIE, B.C.
(Mackenzie Div.)
Pulp—600 metric tpd kraft (for market)

MACKENZIE, B.C.
(Finlay Forest Industries Ltd.)
Pulp—450 metric tpd groundwood
Newsprint—605 metric tpd

ST-FELICIEN, QUE.
(Donohue St-Felicien Inc.)
Pulp—850 metric tpd bleached kraft (FCC's share: 396 tpd)

GRAND RAPIDS, MINN.
(Blandin Paper Co.)
Pulp—330 short tpd (299 metric) mechanical
Coated groundwood—820 short tpd (744 metric)

Total production capacity:

PULP	
Kraft	3,485 metric tpd
TMP	1,250 metric tpd
Mechanical	1,239 metric tpd
Groundwood	450 metric tpd
Total	6,424 metric tpd
PAPER AND BOARD	
Newsprint and specialty	3,185 metric tpd
Kraft specialties and linerboard	240 metric tpd
Coated groundwood	744 metric tpd
Total	4,169 metric tpd

Fort Howard Corp.

1919 S. Broadway
Green Bay, Wis. 54304-9191
Paul J. Schierl, chairman/chief executive officer

Net sales:	
1989	$1,053,634,000
1988	Not available
1987	1,757,728,000
1986	1,549,290,000
1985	1,363,292,000
Net earnings:	
1989	$(239,396,000)
1988	Not available
1987	157,738,000
1986	146,391,000
1985	157,010,000

Fort Howard was taken private in a $3.57-billion leveraged buyout in August 1988. The company did not put out annual sales and earnings figures in that year. It said that because of accounting methods, the figures from before and after the leveraged buyout (LBO) cannot be compared.

Fort Howard is the largest U.S. producer of tissue products sold on the commercial and industrial market. It commands about a 31% share of the U.S. C&I market. Because of the huge debt load it incurred by going private, Fort Howard was forced to postpone some of its expansion plans in the tissue sector of its business. In order to generate much needed cash to pay down its debt and proceed with capital investments, the company sold off its disposable food service products business to a private investor group led by executives of Silgan Corp. of Stamford, Conn., in September 1989. Fort Howard did not reveal the sale price, but the unit had worldwide sales in 1988 of about $925 million.

The operations sold included the former Maryland Cup Corp., which Fort Howard bought in 1983 for $536.2 million, and Lily-Tulip Inc., which was purchased in 1986 for $326 million.

In July 1989, Fort Howard announced an ambitious capital spending program. The company once again said it would add a fourth tissue machine at its greenfield mill in Rincon, Ga.—a plan that was put on hold when the LBO occurred. The fourth tissue machine at the Savannah River mill is slated to start up in mid-1991. The cost of the machine and related equipment is about $125 million.

At the same time, Fort Howard said it will add three tissue machines to its mills in the next five years. In addition to the reinstated fourth machine at Rincon, the company plans to seek permits to expand its three-machine tissue mill in Muskogee, Okla., and its mill in Green Bay, Wis. In April 1989, the company started up a dry form tissue machine at Green Bay, giving the mill eight tissue machines and two dry formers.

Production facilities:

(Fort Howard does not release capacity data; figures below are estimates.)

RINCON, GA.
(Savannah River Mill)
Tissue, towels, napkins—750 tpd

MUSKOGEE, OKLA.
Tissue, towels, napkins—975 tpd

GREEN BAY, WIS.
Tissue, towels, napkins—990 tpd

Total production capacity:

PAPER	
Tissue, towels, napkin	2,715 tpd

Garden State Paper Co. Inc.

411 East Franklin St.
Richmond, Va. 23219
Dr. James L. Burke, president/chief executive officer

(A wholly-owned subsidiary of Media General Inc., which also has a 33% interest in Southeast Paper Mfg. Co. FSC Paper Corp., in which Media General had a 20% interest, was sold to Smorgon Consolidated Industries Pty Ltd. of Australia in May 1987.)

Garden State Paper Co. Inc.	
Net sales:	
1986	$169,989,000
1985	170,713,000

Media General Inc.	
Newsprint segment revenues:	
1989	$131,310,000
1988	226,000,000
1987	204,113,000
1986	173,402,000
1985	174,893,000
Operating profit:	
1989	$18,179,000
1988	44,300,000
1987	36,278,000
1986	17,284,000
1985	17,730,000

Garden State operates a recycled newsprint mill using 100% old news as its fiber source. Sales are made to about 100 customers, mainly daily newspapers within a 200-mi radius of the mill in Garfield, N.J.

Garden State mills recycle about 8% of all newspapers read annually in the U.S. The mills utilize the Garden State technology for making newsprint.

In March 1989, the Pomona, Calif., newsprint recycling mill was sold to Barris Industries/Giant Group Ltd.

In 1990, the company announced plans to sell its Garfield, N.J., flagship mill but could not find a buyer.

A new machine at Southeast's Dublin, Ga., mill will double capacity to 460,000 tpy. The $330-million project started up in September 1989.

Production facilities:

GARFIELD, N.J.
Pulp—700 tpd deinked
Newsprint—610 tpd

Total production capacity:

PULP	700 tpd
PAPER	610 tpd

Gaylord Container Corp.

500 Lake Cook Rd., Suite 400
Deerfield, Ill. 60015
Marvin A. Pomerantz, chairman/chief executive officer

Net sales:	
1989	$746,000,000
1988	671,200,000
1987*	437,800,000
Net income:	
1989	$39,400,000
1988	41,900,000
1987*	19,300,000

(fiscal year ends Sept. 30)
*For the ten-month period between November 1986 and September 1987.

Gaylord initially consisted of Mid-America Packaging and three mills formerly owned by Crown Zellerbach Corp. Early in 1988, Gaylord acquired assets of the container products division of Louisiana-Pacific Corp.'s Fibreboard Corp. subsidiary. In July 1988, Gaylord Container became a public company. It sold its Baltimore, Ohio, recycled paper mill In November 1988 for $17 million.

Gaylord Container Corp. is a major national manufacturer and distributor of corrugated containers, containerboard, unbleached kraft paper, multiwall bags, and, through a joint venture, grocery bags and sacks. The company serves its customers through a network of three paper mills, 16 corrugated container plants, five sheet plants, one preprint facility, and marketing operations throughout the U.S.

In 1988, the company embarked on a three-year, $300-million capital investment program designed to increase productive capacity, improve productivity, and enhance product quality. Major components of the program include installation of a new recovery boiler at the company's Bogalusa, La., mill (completed in November 1989), a complete rebuild of the largest linerboard machine at the Antioch, Calif., mill (completed in February 1990), and installation of a new 1,000-tpd multi-ply linerboard machine at the Bogalusa mill (scheduled for startup in the fall of 1990). In addition, the company has invested approximately $70 million to expand and enhance its converting facilities.

In 1989, the company produced 965,000 tons of containerboard and 275,000 tons of unbleached kraft paper. During the period, the company shipped 10 billion ft^2 of corrugated products and 137 million multiwall bags.

Total capital expenditures in 1989 came to $181 million, and $200 million was expected for 1990.

Production facilities:

PINE BLUFF, ARK.
Unbleached kraft paper—421 tpd bag, sack

ANTIOCH , CALIF.
Containerboard—1,357 tpd

BOGALUSA, LA.
Containerboard and unbleached kraft paper—1,605 tpd

Total production capacity:

PAPER AND BOARD	
Unbleached kraft paper	755 tpd
Containerboard	2,651 tpd
Total	3,406 tpd

Georgia-Pacific Corp.

133 Peachtree St. N.E.
Atlanta, Ga. 30303
T. Marshall Hahn Jr., chairman/chief executive officer

Net sales:	
1989	$10,171,000,000
1988	9,509,000,000
1987	8,603,000,000
1986	7,223,000,000
1985	6,716,000,000
Net income:*	
1989	$661,000,000
1988	467,000,000
1987	458,000,000
1986	296,000,000
1985	207,000,000

*Continuing operations, before unusual items

Georgia-Pacific, one of the largest U.S. producers of building materials, has modified its strategy to achieve a better balance between its paper and building products sectors and to even out performance in business cycles. It is also integrating further, installing two white paper machines at Port Hudson, La., where there was formerly only a market pulp operation. It has switched grades from one mill to another or added grades for optimum mill performance. G-P got out of the chemicals and oil and gas businesses but has added cut-size converting operations at three mills.

In August 1988, the company acquired Brunswick Pulp & Paper Co. from Mead Corp. and Scott Paper Co. for $665 million, expanding G-P's position in market pulp and bleached board.

Sales of pulp and paper in 1989 were $4.042 billion (40% of G-P's total sales). Of this amount, containerboard and packaging accounted for 15% or $1.578 billion, printing/writing papers 10% ($983 million), tissue 7% ($679 million), market pulp 7% ($728 million), and other grades 1% ($74 million).

In 1989, pulp output was 4,915,000 short tons. Paper production included 1,419,000 tons of linerboard and medium, 1,161,000 tons of printing/writing papers, 555,000 tons of other paperboard, 519,000 tons of tissue and sanitary papers, and 350,000 tons of kraft paper. G-P had capacity at the end of 1989 for 5,259,000 tons of pulp and 4,366,000 tons of paper.

Capital expenditures in 1989 were $499 million, $310 million of which went for pulp and paper projects. The company expects to spend $565 million overall in 1990.

Construction of a new recovery boiler was completed in third-quarter 1989 at the Woodland, Maine, mill, adding 23,000 tpy of pulp capacity.

A new recovery boiler at the Brunswick, Ga., pulp and paper mill costing approximately $84 million was expected to be completed in the third quarter of 1990.

On February 20, 1990, G-P and Great Northern Nekoosa Corp. entered into a definitive merger agreement providing for G-P's acquisition of GNN. GNN produces pulp, paper, and containerboard, and it is a major domestic corrugated packaging manufacturer, paper distributor, and envelope manufacturer.

A 10-week strike by the Assn. of Western Pulp & Paper Workers at the Toledo, Ore., linerboard and medium mill ended in May 1990 after the company announced plans to sell the mill.

In the fall of 1990, G-P reached an agreement to sell its Tomahawk, Wis., medium mill, its Valdosta, Ga., linerboard mill, and 19 box plants to PCA and GE Capital for $750 million.

G-P owns 5,430,000 acres of timberland in North America, and it controls 670,000 acres.

Production facilities:
(Does not include GNN.)

BRUNSWICK, GA.
Pulp—1,918 tpd kraft
Bleached board—479 tpd

CROSSETT, ARK.
Pulp—1,518 tpd kraft; 126 tpd deinked
Printing paper—518 tpd
Tissue and towel—447 tpd
Solid bleached board—488 tpd

PALATKA, FLA.
Pulp—1,370 tpd kraft; 19 tpd deinked
Kraft paper—693 tpd
Tissue & toweling—466 tpd

TAYLORVILLE, ILL.
Pulp—22 tpd deinked
Printing/writing paper—112 tpd

GARY, IND.
Pulp—74 tpd deinked
Industrial toweling—74 tpd

PORT HUDSON (Zachary), LA.
Pulp—1,805 tpd bleached kraft
Printing paper—1,570 tpd

WOODLAND, MAINE
Pulp—879 tpd kraft
Printing paper—301 tpd

KALAMAZOO, MICH.
Pulp—164 tpd deinked
Printing paper—384 tpd

MONTICELLO, MISS.
Pulp—2,333 tpd kraft; 513 tpd deinked
Kraft linerboard—2,685 tpd

DELAIR, N.J.
Pulp—230 tpd deinked
Gypsum paperboard—205 tpd

PLATTSBURGH, N.Y.
Pulp—121 tpd semichemical; 27 tpd deinked
Tissue and towel—271 tpd

PRYOR, OKLA.
Pulp—233 tpd deinked
Gypsum paperboard—219 tpd

TOLEDO, ORE.
Pulp—1,493 tpd kraft; 452 tpd deinked
Kraft paper—279 tpd
Kraft linerboard—1,079 tpd
Semichemical medium—515 tpd

READING, PA. (closed in 1990)
Pulp—14 tpd deinked
Printing paper—60 tpd

GILMAN, VT. (sold in 1990)
Pulp—27 tpd deinked
Printing paper—195 tpd

BELLINGHAM, WASH.
Pulp—616 tpd bleached sulfite; 110 tpd semichemical; 33 tpd deinked
Tissue and towel—241 tpd

THOROLD, ONT.
(Beaver Wood Fibre Co.)
Pulp—315 metric tpd deinked
Gypsum paperboard—301 metric tpd

Total production capacity:

PULP (short tons)	
Kraft	11,316 tpd
Semichemical	230 tpd
Sulfite	616 tpd
Deinked	2,250 tpd
Total	14,412 tpd

PAPER (short tons)	
Printing/writing	3,140 tpd
Tissue/towel	1,425 tpd
Kraft paper	973 tpd
Industrial toweling	74 tpd
Total	5,611 tpd

PAPERBOARD (short tons)	
Kraft linerboard	3,764 tpd
Bleached board	967 tpd
Semichemical medium	515 tpd
Gypsum paperboard	725 tpd
Total	5,972 tpd

TOTAL PAPER AND BOARD 11,583 tpd

Gilman Paper Co.

1000 Osborne St.
St. Marys, Ga., 31558
Howard Gilman, chairman/chief executive officer, William H. Davis, president/chief operating officer

Financial data not available.

Gilman's current strategy is to upgrade facilities and switch from brown papers to bleached papers. The company said that most capital expenditures over the next few years will be for pollution-related items.

Net sales for the company were $395 million in 1989 and $362 million in 1988. Approximately 70% of 1989 sales came from pulp, paper, and board products.

Production in 1989 totaled 408,000 short tons of paper and paperboard and 400,000 tons of pulp.

Capital expenditures in 1989 came to $25 million, with about 70% of the amount dedicated to pulp and paper operations. Gilman expected to spend a total of $28 million in 1990.

The company owns 195,000 acres of timberland in the U.S., and it controls 43,000 acres.

Production facilities:

ST. MARYS, GA.
Pulp—1,200 tpd kraft (800 tpd bleached, 400 tpd unbleached)
Paper & board—1,200 tpd (half paper, half board; bleached and unbleached, coated and uncoated)

Total production capacity:

PULP	1,200 tpd
PAPER & BOARD	1,200 tpd

P.H. Glatfelter Co.

228 Main St.
Spring Grove, Pa. 17362
T.C. Norris, chairman/president/chief executive officer

(Glatfelter Pulp Wood Co. is a wholly owned subsidiary.)

Net sales:	
1989	$598,777,000
1988	569,333,000
1987	423,680,000
1986	284,832,000
1985	277,144,000
Net earnings:	
1989	$92,864,000
1988	82,232,000
1987	55,027,000
1986	41,474,000
1985	39,731,000

Glatfelter manufactures printing/writing papers and tobacco and other specialty papers. The company's strategy is to serve niche markets with high-value products in order to avoid more cyclical markets and to emphasize customer service.

The mill at Spring Grove, Pa., is integrated, producing a substantial part of its pulp requirements from wood. The Pisgah Forest, N.C., mill produces flax fiber pulp used to manufacture most of its tobacco industry products and uses purchased virgin wood pulp to make nearly all of Ecusta's printing and other specialty papers. The Neenah, Wis., mill recycles wastepaper for its principal raw material.

In 1989, Glatfelter produced 524,000 tons of paper and paperboard and 302,000 tons of pulp. All company sales are derived from paper and paperboard.

Capital expenditures in 1989 were $56.9 million, and the company expected to spend $66.4 million in 1990.

A $63-million fluidized bed power boiler/turbine generator at Spring Grove, Pa., was completed in 1989 and is near design capacity. It will make the mill self-sufficient in energy and provide electricity to sell. The Spring Grove mill also scheduled a substantial coated paper capacity addition that was to be completed in the latter part of 1990.

Company timberlands, managed by Glatfelter Pulp Wood Co., comprise 107,000 acres.

Production facilities:

PISGAH FOREST, N.C.
(Formerly Ecusta Corp. mill)
Pulp—100 tpd flax
Cigarette and thin—250 tpd

SPRING GROVE, PA.
Pulp—580 tpd bleached kraft
Uncoated free-sheet—700 tpd
Coated free-sheet—120 tpd

NEENAH, WIS.
(Bergstrom Paper Div.)
Pulp—250 tpd bleached deinked
Printing/writing—410 tpd

Total production capacity:

PULP	
Kraft	580 tpd
Deinked	250 tpd
Flax	100 tpd
Total	930 tpd
PAPER	
Printing/writing	1,230 tpd
Cigarette and thin	250 tpd
Total	1,480 tpd

Great Northern Nekoosa Corp.

401 Merritt 7, P.O. Box 5120
Norwalk, Conn. 06856-5120
William R. Laidig, chairman/president/chief executive officer.

(GNN and Georgia Pacific Corp. announced on Feb. 20, 1990 that they have entered into a definitive merger agreement, providing for the acquisition of GNN by NM Acquisition Corp., a wholly owned subsidiary of G-P. Mr. Laidig resigned his position in May, 1990 and was succeeded by Georgia-Pacific's chief operating officer, Ronald P. Hogan, until the merger of the two companies was completed.)

Net sales:	
1989	$3,863,100,000
1988	3,566,300,000
1987	2,576,400,000
1986	2,039,200,000
1985	1,934,800,000
Net income:	
1989	$321,100,000
1988	341,700,000
1987	200,600,000
1986	85,300,000
1985	46,200,000

GNN has six operating divisions: Leaf River Forest Products, market pulp; Nekoosa Papers, business communication papers; Great Northern Paper, newsprint and other groundwood papers; Great Southern Paper and Nekoosa Packaging, containerboard and corrugated containers; and Butler Paper, merchant and envelope converting operations. The company's strategy is to produce a few high-volume products at large, cost-efficient mills.

In 1988, GNN acquired Jim Walter Papers, a paper distributor and envelope manufacturer that now operates as part of Butler Paper.

Ninety-seven percent of GNN's sales come from pulp/paper/board products. In 1989, the company produced 1,589,000 short tons of paper (capacity: 1,620,000 tons); 2,149,000 tons of containerboard (capacity: 2,191,000 tons); and 569,000 tons of market pulp (capacity: 636,000 tons).

Business papers accounted for 19.4% of shipments; newsprint and groundwood, 17.2%; and containerboard, 49.8%.

Capital expenditures in 1989 of $530.6 million included $113.0 million related to pollution abatement. GNN had forecast capital expenditures at $700 million for 1990, however, it expects that its spending program will be reevaluated after the acquisition of GNN by G-P is completed.

GNN and MD Papier, a West German paper manufacturer, completed a feasibility study of a joint venture to build a $565-million lightweight coated paper facility. In February 1990, however, MD Papier requested that formal formation of the joint venture be put on standby status due to the acquisition by G-P.

The $575-million expansion of the Nekoosa Papers mill at Ashdown, Ark., is proceeding on schedule. The project includes a new 325,000-tpy uncoated free-sheet paper machine, which will be the world's largest such machine upon startup in mid-1991.

In April 1989, the mill completed construction of a $90-million recovery boiler that will increase market pulp production by 90,000 tpy. Also in 1989, GNN purchased the 5% minority interest in Leaf River owned by Kymmene Corp. for $31.8 million.

GNN owns 3.4 million acres of timberland in the U.S. and controls 233,000 acres.

Production facilities:

ASHDOWN, ARK.
(Nekoosa Papers)
Pulp—1,700 tpd bleached kraft (140 tpd for market)
Business communication paper—1,340 tpd

CEDAR SPRINGS, GA.
(Great Southern Paper)
Pulp—2,395 tpd kraft; 515 tpd semichemical
Linerboard—2,395 tpd
Corrugating medium—665 tpd

EAST MILLINOCKET, MAINE
(Great Northern Paper)
Pulp—725 tpd groundwood
Newsprint—920 tpd

MILLINOCKET, MAINE
(Great Northern Paper)
Pulp—710 tpd groundwood; 525 tpd sulfite
Groundwood paper, newsprint—1,215 tpd

NEW AUGUSTA, MISS.
(Leaf River Forest Products)
Pulp—1,540 tpd bleached kraft pulp (for market)

NEKOOSA, WIS.
(Nekoosa Papers)
Pulp—380 tpd kraft
Business communication paper—612 tpd

PORT EDWARDS, WIS.
(Nekoosa Papers)
Pulp—250 tpd sulfite
Business communication paper—450 tpd

VALDOSTA, GA.
(Nekoosa Packaging Corp.)
Pulp—1,125 tpd kraft
Linerboard—1,075 tpd

BIG ISLAND, VA.
(Nekoosa Packaging Corp.)
Pulp—720 tpd semichemical
Corrugating medium—815 tpd

TOMAHAWK, WIS.
(Nekoosa Packaging Corp.)
Pulp—1,075 tpd semichemical
Corrugating medium—1,245 tpd

Total production capacity:

PULP	
Kraft	7,140 tpd
Semichemical	2,310 tpd
Groundwood	1,435 tpd
Sulfite	775 tpd
Total	11,660 tpd

PAPER AND BOARD	
Newsprint, groundwood	2,135 tpd
Business papers	2,402 tpd
Linerboard	3,470 tpd
Corrugating medium	2,725 tpd
Total	10,732 tpd

Green Bay Packaging Inc.

Box 19017
Green Bay, Wis. 54307-9017
James F. Kress, president/chief executive officer

Financial data not available.

Green Bay is a diversified, privately owned company with interests in containerboard, converting, lumber, and machinery. Arkansas Kraft, formerly a subsidiary, became a division in March 1987.

Linerboard output at Arkansas Kraft in 1989 was 356,675 short tons, which included 120,382 of mottled white. The Green Bay mill produced 125,067 tons of medium.

Production facilities:

MORRILTON, ARK.
(Arkansas Kraft mill)
Pulp—800 tpd unbleached kraft
Kraft linerboard—1,075 tpd (includes 450 tpd mottled white)

GREEN BAY, WIS.
(Green Bay mill)
Pulp—240 tpd semichemical
Corrugating medium—425 tpd

Total production capacity:

PULP	
Unbleached kraft	800 tpd
Semichemical	240 tpd
Total	1,040 tpd

PAPERBOARD	
Kraft linerboard	1,075
Corrugating medium	425
Total	1,500

Gulf States Paper Corp.

Box 3199
Tuscaloosa, Ala. 35404
J.W. Warner, chairman/chief executive officer

Financial data not available.

Gulf States announced in November 1989 that it planned to double the pulping capacity of its Demopolis, Ala., mill, serving as a prelude to the installation of an additional board machine at the mill. The $250-million investment for Phase I of the expansion, which will take four years to complete, is the largest in the company's 105-year history.

The expansion is expected to increase bleached kraft pulp production to 1,500 tpd. Improvements will also be made to the wood-handling and paperboard production areas of the mill.

Phase II of the project is not expected to begin until the mid-1990s.

The company owns or controls approximately 400,000 acres of U.S. timberland.

Production facilities:

DEMOPOLIS, ALA.
Pulp—750 tpd bleached kraft (75 tpd deinked)
Paperboard—750 tpd bleached coated paperboard

Total production capacity:

PULP	750 tpd
PAPERBOARD	750 tpd

International Paper Co.

2 Manhattanville Rd.
Purchase, N.Y. 10577
John A. Georges, chairman/chief executive officer

(IP owns one-third of Grays Harbor Paper Co. through its acquisition of Hammermill Paper Co.)

Net sales:	
1989	$11,378,000,000
1988:	9,533,000,000
1987	7,763,000,000
1986	5,500,000,000
1985	4,502,900,000
Net income:*	
1989	$864,000,000
1988	754,000,000
1987	407,000,000
1986	305,000,000
1985	133,300,000

*Reflects extraordinary items.

International Paper enters the 1990s a strong, well-positioned company after completing a major restructuring program over the preceeding ten years. The company spent $7 billion rebuilding its mill system to improve quality and efficiency, increase capacity, and lower costs. IP also realigned its business operations by selling its Canadian holdings in 1981 and withdrawing from the newsprint business by 1985.

Acquisitions have played a central role in the company's improvement. The twenty acquisitions since 1985 have involved more than $4 billion, ranging in cost from $10 million to $1.5 billion each. The company's most recent major acquisition was Zanders Feinpapiere, based in Fed. Rep. Germany. Zanders joined IP at the start of 1990. Zanders occupies a major position in the world coated papers market.

IP is one of the largest paper companies in the world, with 27 pulp and paper mills in the U.S. and overseas. Among the grades produced are uncoated free-sheet, coated papers, bristols, paper and specialty pulp, containerboard, bleached board, and kraft packaging.

Net sales by the pulp & paper segment increased 21% in 1989 to $3.7 billion, compared with $3.1 billion in 1988. Paperboard and packaging sales rose 4% to $3.4 billion compared with $3.3 billion in 1988.

In 1989, output of printing/writing papers and bristols was 2.6 million tons; coated papers, 608,000 tons; and market pulp, 1.1 million tons. Production of containerboard was 2.0 million tons; bleached board, 989,000 tons; and industrial papers, 593,000 tons.

Capital expenditures for 1989 were $360 million for pulp and paper projects and $276 million for paperboard and packaging projects. IP plans to spend about $1.1 billion on capital projects in 1990.

Work under way at IP's Pine Bluff, Ark., mill is expected to increase output of liquid packaging board approximately 14%. Investments to enhance recent acquisitions are also part of the company's 1990 capital program. Improvements are being made at Aussedat Rey facilities in France, and Zanders is planning to add a paper machine at its mill in Gohrsmühle, Fed. Rep. Germany.

Capital spending to improve environmental performance will more than double in 1990 compared with 1989.

IP controls 6.4 million acres of timberlands, 6.2 million of which are held through its majority ownership of Timberlands Ltd.

Production facilities:

(IP does not release capacity figures; the following are from published sources or are estimates.)

International Paper Co.

MOBILE, ALA.
Pulp—1,035 tpd kraft
Uncoated free-sheet—1,000 tpd
Packaging/industrial converting paper—85 tpd

CAMDEN, ARK.
Pulp—800 tpd
Packaging/industrial converting paper—715 tpd

PINE BLUFF, ARK.
Pulp—1,600 tpd bleached and unbleached kraft
Publication paper—565 tpd
Solid bleached board—1,150 tpd

BASTROP, LA.
Pulp—1,200 tpd bleached kraft
Printing/writing paper—500 tpd
Solid bleached board—550 tpd

MANSFIELD, LA.
Pulp—2,050 tpd unbleached kraft
Linerboard—1,300 tpd
Corrugating medium—750 tpd

PINEVILLE, LA.
Pulp—975 tpd unbleached kraft
Unbleached kraft board—985 tpd

JAY, MAINE
Pulp—1,200 tpd bleached kraft; 245 tpd groundwood
Printing/writing paper—1,350 tpd

MOSS POINT, MISS.
Pulp—750 tpd kraft
Printing/writing paper—150 tpd
Packaging/industrial converting paper and solid bleached board—785 tpd

NATCHEZ, MISS.
Pulp—650 tpd bleached kraft; 500 dissolving (for market)

VICKSBURG, MISS.
Pulp—1,180 tpd kraft
Unbleached kraft board—1,350 tpd

CORINTH, N.Y.
Pulp—150 tpd groundwood
Printing/writing paper—480 tpd

TICONDEROGA, N.Y.
Pulp—530 tpd bleached kraft
Printing/writing paper—690 tpd

GARDINER, ORE.
Pulp—850 tpd kraft
Unbleached kraft board—850 tpd

RIEGELSVILLE, PA.
(formerly Durham Mill Inc.)
(Mill idle)
Recycled paperboard—375 tpd linerboard, specialty

GEORGETOWN, S.C.
Pulp—1,600 tpd bleached kraft (915 for market)
Uncoated free-sheet—370 tpd
Bleached bristol—345 tpd

TEXARKANA, TEXAS
Pulp—1,300 tpd kraft (estimated 500 tpd for market)
Bleached paperboard—1,300 tpd

MERRILL, WIS.
(Former Ward Paper Co. mill of Arvey Corp.)
Pulp—60 tpd deinking
Fine, specialty papers—100 tpd

Hammermill Paper Div.

SELMA, ALA.
(Riverdale Plant, HPG)
Pulp—1,100 tpd bleached kraft (440 tpd for market)
Uncoated free-sheet—530 tpd
WESTFIELD, MASS.
(Strathmore Paper Co., including facilities at Westfield, Millers Falls, Turners Falls and Woronoco, Mass.)
Printing/writing paper—130 tpd

OSWEGO, N.Y.
Printing/writing paper—210 tpd

HAMILTON, OHIO
(Beckett Paper Co.)
Printing/writing paper—150 tpd

ERIE, PA.
Pulp—680 tpd Neutracel II bleached alkaline (for market)
Printing/writing paper—470 tpd

LOCK HAVEN, PA.
Printing/writing paper—675 tpd

HOQUIAM, WASH.
(Grays Harbor Paper Co., jointly owned)
Printing/writing, related paper—375 tpd

DE PERE, WIS.
(Nicolet Div. of Thilmany Pulp & Paper—former Philip Morris mill)
Paper—140 tpd glassine, greaseproof, release, sanitary waxing

KAUKAUNA, WIS.
(Thilmany Pulp & Paper)
Pulp—430 tpd bleached and unbleached kraft
Packaging industrial converting paper—555 tpd

Total production capacity:

PULP	
Kraft	17,250 tpd
Groundwood	395 tpd
Dissolving	500 tpd
Neutracel	680 tpd
Deinking	60 tpd
Total	18,885 tpd

PAPER	
Printing/writing	5,745 tpd
Uncoated free-sheet	1,900 tpd
Fine	100 tpd
Specialty	140 tpd
Packaging/industrial converting*	2,140 tpd
Bleached bristols	345 tpd
Total	10,370 tpd

*Includes some solid bleached board

PAPERBOARD	
Bleached paperboard	3,000 tpd
Linerboard	1,300 tpd
Unbleached kraft board	3,185 tpd
Corrugating medium	750 tpd
Recycled board	375 tpd
Total	8,610 tpd
TOTAL PAPER AND BOARD	18,980 tpd

Interstate Resources Inc.

1800 N. Kent St., Suite 1200
Rosslyn, Va. 22209
Fares Korkmaz, acting chief executive officer

Financial data not available.

One hundred percent of Interstate's sales are derived from pulp, paper/board, and converted products. Interstate sells on the open market and supplies Interstate container plants in Reading, Pa., and Lowell, Mass.

Total capital expenditures in 1989 were $12.9 million. The company expected to spend $12.0 million in 1990 on programs to introduce process improvements in existing plants as well as on the completion of a TRS compliance program at one location.

Production facilities:

RICEBORO, GA.
(Interstate Paper Corp.)
Pulp—530 short tpd kraft
Linerboard—690 short tpd

READING, PA.
(Interstate Intercorr Corp.)
Recycled corrugating medium—100 tpd

Total production capacity:

PULP	530 tpd

PAPERBOARD	
Linerboard	690 tpd
Recycled corrugating medium	100 tpd
Total	790 tpd

Irving Pulp & Paper Ltd.

Box 3007, Station B
Saint John, N.B. E2M 3H1
J.K. Irving, president

Financial data not available.

Following acquisition of the St. John, N.B., mill from Kimberly-Clark Corp. early in 1988, Irving announced it would install a new 60,000-tpy tissue machine at the mill. The machine was started up in November 1989. Members of the Canadian Paperworkers Union struck the tissue mill for several weeks in the spring, but a strike by over 400 maintenance workers at Rothesay Paper entered its seventh month in November 1990. The mill was running one of its paper machines at full capacity and occasionally operated the other.

Production facilities:
(Before the new tissue machine.)

SAINT JOHN, N.B.
(Irving Pulp & Paper Ltd.)
Pulp—825 metric tpd bleached and semibleached kraft (for market)

SAINT JOHN, N.B.
(Rothesay Paper Ltd.)
Pulp—525 metric tpd groundwood; 400 metric tpd thermomechanical
Newsprint—950 metric tpd

SAINT JOHN, N.B.
(Irving Tissue Co.)
No. 1 crepe wadding machine—44 metric tpd
No. 2 crepe wadding machine—165 metric tpd
ST. GEORGE, N.B.
(Lake Utopia Paper Ltd.)
Corrugating medium—225 metric tpd

Total production capacity:

PULP	
Kraft	825 metric tpd
Groundwood	525 metric tpd
TMP	300 metric tpd
Total	1,650 metric tpd

PAPER AND BOARD	
Newsprint	950 metric tpd
Tissue	209 metric tpd
Corrugating medium	225 metric tpd
Total	1,384 metric tpd

ITT Rayonier Inc.

1177 Summer St.
Stamford, Conn. 06904
Ronald M. Gross, chairman/president/chief executive officer

(ITT Rayonier Inc. is a subsidiary of ITT Corp. ITT Rayonier jointly owns two-thirds of Grays Harbor Paper Co. with Hammermill Paper Div. of International Paper Co., which operates the mill and markets its products.)

Net sales (Pulp & Forest Products Div.):	
1989	$1,082,000,000
1988	1,010,000,000
1987	757,000,000
1986	669,000,000
1985	612,000,000
Net income	
1989	$127,956,000
1988	61,492,000

Although reduced in size, ITT Rayonier is still a major producer of dissolving, paper-grade, and fluff market pulp at three mills (Jesup, Ga.; Fernandina Beach, Fla.; and Port Angeles, Wash.) Of these, the Jesup kraft mill is believed to be the most modern and cost-efficient. The Hoquiam, Wash., pulp mill supplies mainly the adjacent Grays Harbor Paper joint-venture mill. The company has prospered recently from improving markets for dissolving pulp, strong pricing, and reduced production costs at some mills.

Over 250 members of the Assn. of Western Pulp & Paper Workers struck the Hoquiam mill Aug. 26, 1990 over union opposition to a two-tier wage structure. The company continued to operate the mill with management and temporary employees.

Approximately 60% of total sales—$647 million in 1989—are derived from pulp operations. The company produced 876,000 metric tons of pulp in 1989. Capacity in 1990 is 960,000 metric tpy. Capital spending in 1989 was $80 million.

Operating income for 1989 was $226.4 million, $54.3 million higher than 1988.

Most timberland properties are owned or leased by Rayonier Timberlands LP, a publicly held master limited partnership of which ITT Rayonier Inc. and Rayonier Forest Resources Co. are general partners. Total ITT Rayonier and Rayonier Timberlands LP comprise 1,124,000 acres owned and 138,000 acres controlled.

Production facilities:

FERNANDINA BEACH, FLA.
(Fernandina Div.)
Pulp—425 tpd sulfite (for market)

JESUP, GA.
(Jesup Div.)
Pulp—1,470 tpd bleached kraft (for market)

HOQUIAM, WASH.
(Grays Harbor Div.)
Pulp—310 tpd sulfite

HOQUIAM, WASH.
(Grays Harbor Paper Co.)
Paper (see International Paper Co.)

PORT ANGELES, WASH.
(Port Angeles Div.)
Pulp—445 tpd sulfite (for market)

Total production capacity:

PULP	
Sulfite	1,180 tpd
Kraft	1,470 tpd
Total	2,650 tpd

James River Corp.

Box 2218
Richmond, Va. 23217
Brenton S. Halsey, chairman
Robert C. Williams, president, chief executive officer

(James River owns 80% of James River-Marathon Ltd.; Buchanan Forest Products Ltd. owns 20%. In December 1987, James River completed the purchase of a 50% interest in Kaysersberg SA of France.)

Net sales:	
1990	$5,949,987,000
1989	5,871,773,000
1988	5,097,978,000
1987	4,479,001,000
1986	2,606,950,000
1985	2,492,009,000
Net income:	
1990	$221,564,000
1989	255,065,000
1988	209,010,000
1987	169,864,000
1986	95,288,000
1985	101,351,000

(Fiscal year ends Apr. 30.)

James River is one of the world's leading producers of pulp, paper, and converted paper and plastic products. The company manufactures and converts products for five major markets: hygienics products, communication papers, disposable food service products, food and consumer packaging, and specialty papers. The company has pursued an aggressive growth strategy, which has expanded its business both domestically and abroad. With its subsidiaries and affiliates, James River encompasses 160 manufacturing facilities, located in 12 countries, with over 34,000 employees in North America and 12,000 in Europe.

In the fiscal year ending in April 1990, hygienics products sales were $1,652.1 million (27.8% of total sales); communication papers, $1,272.0 million (21.4%); packaging, $999.6 million (16.8%); and specialty industrial and packaging papers, $824.6 million (13.8%). Sales of market pulp accounted for 3.8% of total sales.

Total capital expenditures (including acquisitions) were $574.6 million in fiscal 1990. Of that amount, $426.5 million was spent on paper and other products operations.

In fiscal 1990, James River announced plans to divest more than $1.3 billion in assets in a major restructuring. Some mills were expected to be closed as the company attempted to became more focused. As a part of this process, the company earlier shut down unprofitable operations, such as its J-Mass specialty papers mill in Fitchburg, Mass., and divested its nonstrategic divisions, such as its Nonwovens and Health Care divisions. JR's West Linn, Ore., printing papers mill was to be sold to Simpson Paper.

In November 1989, James River started up a $29-million recycling facility in Green Bay, Wis. At full capacity, this operation will produce 70,000 tpy of recycled fiber for JR's tissue facility there. At the end of fiscal 1990, the company completed the second phase of its $51-million modernization project, which will add 50,000 tpy of pulping capacity, at the Camas, Wash., pulp and paper mill.

In June 1989, JR began a $52-million project to modernize the company's Naheola pulp and paper mill in Pennington, Ala. Also, in May 1990, JR announced plans to construct a $157-million chemical recovery unit and related black liquor concentration system at that facility. The combined projects will ultimately expand the mill's pulping capacity by about 100,000 tpy.

During fiscal 1990, the company announced plans to approximately double the capacity of its Marathon, Ont., pulp mill. And on June 14, 1990, the James River Board authorized construction of a $65-million facility to recycle wastepaper at the company's Halsey, Ore., mill. With a target completion date of mid-1992, this new plant will supply up to 300 tpd of recycled fiber for towel and tissue products and some communication grades manufactured at the company's northwest mills.

James River owns interests in or manages approximately 4 million acres of forests, although it did sell its wholly owned subsidiary James River Timber Corp. in September 1989.

Production facilities:
(The following are estimates)

Communication Papers Business

NEWARK, DEL.
(Curtis Mills Div.)
Cotton papers—24 tpd

ST. FRANCISVILLE, LA.
(Former Crown Zellerbach mill)
Pulp—633 tpd
Uncoated free-sheet—249 tpd
Coated groundwood—521 tpd
Bristols—99 tpd
Tissue—8 tpd

ADAMS, MASS.
(Curtis Mills Div.)
Uncoated free-sheet—35 tpd

YPSILANTI, MICH.
(Curtis Mills Div.)
Uncoated free-sheet—50 tpd

BERLIN, N.H.
(Pulp Div.)
Pulp—1,328 tpd

GORHAM, N.H.
(Paper Div.)
Uncoated free-sheet—319 tpd
Tissue—160 tpd

GROVETON, N.H.
Uncoated free-sheet—299 tpd
Tissue—57 tpd
CLATSKANIE, ORE.
(Wauna Mill)
Pulp—284 tpd
Tissue—248 tpd
Uncoated free-sheet—249 tpd
Uncoated groundwood—347 tpd

WEST LINN, ORE.
Pulp—65 tpd
Uncoated groundwood—79 tpd
Coated free-sheet—59 tpd
Coated groundwood—347 tpd
Tissue—11 tpd

CAMAS, WASH.
Pulp—1,304 tpd
Tissue—351 tpd
Uncoated free-sheet—698 tpd

MARATHON, ONT.
(James River-Marathon Ltd.)
Pulp—500 metric tpd (551 short)

Packaging Business

KALAMAZOO, MICH.
Recycled paperboard—475 tpd

Specialty Papers Business

JAY, MAINE
(James River-Otis Div.)
Thin papers—52 tpd

EAST PEPPERELL, MASS.
(James River-Pepperell Inc.)
Specialty paper—78 tpd

FITCHBURG, MASS.
(James River-Fitchburg Div.)
Specialty paper—36 tpd

WEST SPRINGFIELD, MASS.
(Premoid Div.)
Specialty paper—15 tpd

PARCHMENT, MICH.
(KVP Paper Div.)
Uncoated free-sheet—249 tpd
Coated free-sheet—69 tpd

PORT HURON, MICH.
(Dunn Paper Div.)
Thin papers—157 tpd

ROCHESTER, MICH.
(Filtration Products Div.)
Specialty paper—25 tpd

WIGGINS, MISS.
(Dunn Paper Div.)
Thin papers—57 tpd

MILFORD, N.J.
(Riegel Custom Products Div.)
Specialty paper—154 tpd

HUGHESVILLE, N.J.
(Riegel Custom Products Div.)
Specialty papers—41 tpd

WARREN GLEN, N.J.
(Riegel Packaging Papers Div.)
Specialty papers—70 tpd

BROWNVILLE, N.Y.
(Premoid Div.)
Specialty paper—30 tpd

RICHMOND, VA.
(Filtration Products Div.)
Specialty paper—27 tpd

Towel & Tissue Business

PENNINGTON, ALA.
(Naheola Mill)
Pulp—1,376 tpd kraft
Bleached board—659 tpd
Tissue—628 tpd

OLD TOWN, MAINE
Pulp—1,195
Tissue—212 tpd

BERLIN, N.H.
(Gorham Absorbent Products)
Tissue—162 tpd

CARTHAGE, N.Y.
Deinked pulp—139 tpd
Tissue—139 tpd

GOUVERNEUR, N.Y.
(Nonwovens Div.)
Tissue—38 tpd

SOUTH GLENS FALLS, N.Y.
(Former Crown Zellerbach mill)
Deinked pulp—183 tpd
Tissue—135 tpd

HALSEY, ORE.
Tissue—270 tpd

ASHLAND, WIS.
Tissue—59 tpd

GREEN BAY, WIS.
Pulp—171 tpd bleached sulfite
Tissue—503 tpd

Total production capacity:

PULP	
Kraft, groundwood	6,592 tpd
Bleached sulfite	171 tpd
Deinked	382 tpd
Total	7,145 tpd
PAPER AND BOARD	
Tissue	2,981 tpd
Uncoated free-sheet	2,148 tpd
Coated groundwood	868 tpd
Uncoated groundwood	426 tpd
Thin papers	266 tpd
Coated free-sheet	128 tpd
Bristols	99 tpd
Cotton-fiber papers	24 tpd
Specialty paper (may include other grades)	833 tpd
Bleached board	659 tpd
Recycled board	475 tpd
Total	8,907 tpd

Jefferson Smurfit Corp.

(Subsidiary of Jefferson Smurfit Group plc, Ireland)
8182 Maryland Ave.
Jefferson Smurfit Centre
St. Louis, Mo. 63105
Michael W.J. Smurfit, chairman/chief executive officer

(Jefferson Smurfit Group plc holds 50%. JSC owns 80% of Smurfit Newsprint Corp. [Times Mirror Co., 20%]; 100% of Container Corp. of America; and 50% of the Monroe, Mich., mill [Monroe Paper Co., 50%]. On Dec. 14, 1989, SIBV/MS Holdings Inc.[Holdings] acquired all of the common stock of JSC. The common stock of Holdings is owned equally by Smurfit Packaging Corp., an indirect wholly owned subsidiary of JS Group, and the Morgan Stanley Leveraged Equity Fund II, L.P. and other investors [collectively, the MSLEF II Group]. Concurrent with the Holdings acquisition of JSC, the common equity of CCA owned by MSLEF I group was acquired by CCA, thereby making CCA an indirect, wholly owned subsidiary of JSC.)

Financial data for the year ended Dec. 31, 1989, includes CCA's results of operations as if CCA were consolidated with JSC as of Jan. 1, 1989.

Jefferson Smurfit Corp.	
Net sales:	
1989	$2,936,285,000
1988	1,255,273,000
1987	1,099,465,000
1986	944,356,000
1985	630,425,000
Net income:	
1989*	$35,808,000
1988	144,495,000
1987	91,996,000
1986	28,003,000
1985	16,826,000

Container Corp. of America	
Net sales:	
1988	$1,731,190,000
1987	1,535,473,000
1986	1,683,654,000
1985	1,772,356,000
Net income:	
1988	$126,557,000
1987	87,071,000
1986	-9,032,000
1985	40,991,000

*Income after extraordinary item.

Jefferson Smurfit Corp. is a major recycler of wastepaper (3.6 million tons in 1988), and it produces recycled paperboard, spiral cores and tubes, and newsprint.

Approximately 30% of JSC/CCA's sales come from pulp, paper/board, and converted products. In 1989, production of paperboard in 1989 was 2.8 million tons; newsprint, 582,000 tons; and reclaimed and brokered fiber, 3.3 million tons.

Capital expenditures in 1989 totaled $201.3 million, and $161 million was expected to be spent in 1990.

JSC/CCA announced in May 1990 that it had agreed to purchase Keystone Container Corp. of St. Louis, Mo., for an undisclosed amount, increasing the number of its corrugated plants to 54. JSC/CCA is the third largest producer of corrugated containers in the U.S.

JSC/CCA is in the final phase of a three-year, $65-million modernization program at its Jacksonville, Fla., mill. The project, which began in 1988, will raise capacity 265 tpd to 1,100 tpd. The company plans to reactivate an idle machine at its Fernandina Beach, Fla., mill to produce recycled containerboard. JSC also said it would build a greenfield recycled newsprint mill in New York State.

JSC/CCA owns or leases 1,000,000 acres of timberland in the U.S.

Production facilities:

JACKSONVILLE, FLA.
Pulp—825 tpd unbleached kraft
Kraft linerboard—850 tpd

CEDARTOWN, GA.
Tube stock—60 tpd

ALTON, ILL.
Recycled corrugating medium—620 tpd

LAFAYETTE, IND.
Tube stock, chipboard—125 tpd

MONROE, MICH.
Tube stock, chipboard—130 tpd

MONROE, MICH.
(Jointly owned with Monroe Paper Co.)
Recycled paperboard—200 tpd (JSC's share: 100 tpd)

LOCKLAND, OHIO
Recycled boxboard—305 tpd

MIDDLETOWN, OHIO
Recycled boxboard—315 tpd

NEWBERG, ORE.
(Smurfit Newsprint Co.)
Pulp—510 tpd refiner mechanical; 530 tpd deinked; 40 tpd semibleached kraft
Newsprint—1,050 tpd

OREGON CITY, ORE.
(Smurfit Newsprint Co.)
Pulp—305 tpd thermomechanical; 345 tpd deinked; 35 tpd semibleached kraft
Newsprint—650 tpd

BREWTON, ALA.
Pulp—1,200 tpd kraft
Unbleached kraft board—815 tpd
Solid bleached board—515 tpd

SANTA CLARA, CALIF.
Recycled board—310 tpd

VERNON, CALIF.
Recycled boxboard—130 tpd
Recycled medium—360 tpd

FERNANDINA BEACH, FLA.
Pulp—2,000 tpd kraft
Unbleached kraft board—2,400 tpd

CARTHAGE, IND.
Recycled medium—130 tpd

WABASH, IND.
Recycled board—340 tpd

CIRCLEVILLE, OHIO
Pulp—250 tpd semichemical
Semichemical corrugating medium—325 tpd

PHILADELPHIA, PA.
Recycled board—450 tpd

TACOMA, WASH.
Recycled board—100 tpd

Total production capacity:

PULP	
Kraft	4,025 tpd
Refiner mechanical	510 tpd
Semibleached kraft	75 tpd
Semichemical	250 tpd
TMP	305 tpd
Deinked	875 tpd
Total	6,040 tpd

PAPER AND BOARD	
Newsprint	1,700 tpd
Linerboard	850 tpd
Kraft board	3,730 tpd
Corrugating medium	945 tpd
Recycled board	2,150 tpd
Tube, chipboard	315 tpd
Total	10,180 tpd

Kimberly-Clark Corp.

Box 619100, DFW Airport Station
Dallas, Texas 75261-9100
Darwin E. Smith, chairman/chief executive officer

(Subsidiaries include Kimberly-Clark of Canada Ltd., 100% owned, and Spruce Falls Power & Paper Co. Ltd., 50.5% owned [49.5% by New York Times Co.].)

Net sales:	
1989	$5,733,600,000
1988	5,393,500,000
1987	4,884,700,000
1986	4,303,100,000
1985	4,072,900,000
Net income:	
1989	$423,800,000
1988	378,600,000
1987	325,200,000
1986	269,400,000
1985	267,100,000

Kimberly-Clark manufactures a wide range of products for personal and health care at home and away from home. It also makes technical and specialty papers as well as newsprint and other communication papers. A key strategy is research and development into new technologies and improvement of existing ones, mostly those based on cellulose formation.

Sales of tissue, home and hospital health care products, wipes, and related products totaled $4.5 billion in 1989. Sales of printing/writing papers and technical/specialty/industrial papers were $1.1 billion.

Capital expenditures were $696.4 million in 1989 That year, K-C embarked on the largest capital spending program in its history and announced that it expected to spend $2 billion on capital projects in 1989-90. An important part of the major increase in capital spending was for new consumer and service and industrial tissue facilities or equipment.

In 1990, K-C completed a new consumer tissue mill in Jenks, Okla., and a commercial tissue mill at Loudon, Tenn.

In third-quarter 1989, Neenah Paper completed a $28-million expansion of the Whiting, Wis., mill. Addition of No. 7 paper machine at the mill, which produces cotton-content paper, sulfite paper, text and cover paper, and specialty paper, increased production 30%.

Third-quarter 1989 also saw the startup of the $20-million wastewater treatment system at the Terrace Bay, Ont., pulp mill.

In June 1990, K-C's small converting plant on a 35-acre site in Maumelle, Ark., began producing pre-moistened wipes. For competitive reasons, K-C would not identify the capacity at the site.

K-C owns 420,000 acres of timberland in the U.S. and leases 48,000 more. In Canada, it manages 11.5 million acres or leases and owns 196,000 acres. The Terrace Bay, Ont., mill is supported by 7.6 million acres of forestland; Spruce Falls is supported by 4.1 million acres.

Production facilities:
(1988/89 figures)

COOSA PINES, ALA.
(Coosa River Newsprint)
Pulp—1,200 tpd kraft; 775 tpd groundwood; 120 tpd thermomechanical
Newsprint, groundwood printing paper—1,118 tpd

FULLERTON, CALIF.
Tissue, cellulose wadding—185 tpd

NEW MILFORD, CONN.
Tissue, towels—200 tpd

LEE, MASS.
Cigarette, lightweight specialties—85 tpd

MUNISING, MICH.
(Technical Paper)
Writing, map, specialties—100 tpd

SPOTSWOOD, N.J.
Cigarette plug wrap—130 tpd

ANCRAM, N.Y.
Cigarette plug wrap, technical specialties—15 tpd

BEECH ISLAND, S.C.
Tissue, wadding, towels—270 tpd

MEMPHIS, TENN.
Tissue, wadding, towels—310 tpd

NEENAH, WIS.
(Neenah Paper)
Tissue, wadding, towels—275 tpd

NEENAH, WIS.
Wadding, industrial wipers—60 tpd

WHITING (Stevens Point), WIS.
(Neenah Paper)
Bond, cover, text paper—40 tpd

HUNTSVILLE, ONT.
(Kimberly-Clark of Canada)
Wadding—100 metric tpd (110 short)

KAPUSKASING, ONT.
(Spruce Falls Power & Paper Co. Ltd.)
Pulp—635 metric tpd (700 short) groundwood (K-C's share: 354 short tpd); 381 metric tpd (420 short) thermomechanical (K-C's share: 212 short tpd); 181 metric tpd (200 short) magnefite (K-C's share: 101 short tpd)
Newsprint, groundwood printing—1,025 metric tpd (1,130 short) (K-C's share: 571 short tpd)

ST. CATHARINES, ONT.
(Kimberly-Clark of Canada)
Specialty tissue, lightweight—104 metric tpd (115 short)

TERRACE BAY, ONT.
(Kimberly-Clark of Canada)
Pulp—1,135 metric tpd (1,251 short) bleached kraft (some for market)

Total production capacity:

PULP (short tons)	
Kraft	2,451 tpd
Magnefite	101 tpd
Groundwood	1,129 tpd
TMP	332 tpd
Total	4,013 tpd

PAPER (short tons)	
Newsprint/groundwood specialty	1,689 tpd
Tissue	1,410 tpd
Printing/writing, specialty	155 tpd
Cigarette	230 tpd
Technical	100 tpd
Total	3,584 tpd

Kruger Inc.

3285 Bedford Rd.
Montreal, Que. H3S 1G5
Joseph Kruger II, chairman/chief executive officer

Financial data not available. All sales are derived from paper products, recycled board, and corrugated containers from recycled board.

Kruger is Canada's largest privately owned company in the industry, and it had the first mill to offer newsprint for flexographic printing on a commercial basis.

In 1984, Kruger purchased Bowater Inc.'s Corner Brook, Nfld., mill (now Corner Brook Pulp and Paper Ltd.) and by 1989, had completed a five-year, C$250-million improvement program involving the rebuild of four machines, along with two more thermomechanical pulp lines.

Rebuilt No. 7 newsprint machine started

operations in 1989. Mill capacity has been increased to 2,050 metric tpd. The construcion of No. 10 paper machine at the Trois-Rivières, Que., mill was to be completed by the end of 1990. This 300-in.-trim machine will produce 180,000 metric tpy of newsprint, bringing the company's annual capacity to over 1 million metric tons.

The company is converting a newsprint machine to SC paper at its Corner Brook, Nfld., mill, as part of an effort to raise total SC capacity by 300% to 100,000 tpy. In the fall of 1990, Kruger obtained a C$18-million loan from the Quebec government to build a 150,000-tpy deinking line at its Bromptonville, Que., mill. The projected was expected to be finished in fall 1991.

Major capital investments are being made toward environmentally friendly technology, forest management and protection, and recycling.

Production facilities:

CORNER BROOK, Nfld.
Pulp—150 metric tpd sulfite; 875 metric tpd thermomechanical
Newsprint—1,025 metric tpd

BROMPTONVILLE, QUE.
(Newsprint Div.)
Pulp—680 metric tpd thermomechanical
Newsprint—580 metric tpd

MONTREAL, QUE.
(Turcot Paperboard Div.)
Recycled paperboard—300 metric tpd

REXDALE, ONT.
Corrugated containers (from recycled and virgin board)—680,000,000 ft²/year

TROIS RIVIÈRES, QUE.
Pulp—650 metric tpd groundwood
Kraft—250 tpd
Newsprint—1,100 metric tpd
Coated publication paper—350 metric tpd
SC-B—200 metric tpd
(including PM No. 10)

VILLE LASALLE, QUE
Corrugated containers (from recycled and virgin board)—1,164,000,000 ft²/year

PULP	
Groundwood	650 metric tpd
Sulfite	150 metric tpd
TMP	2,305 metric tpd
Kraft	250 tpd
Total	3,355 metric tpd (consumed on site)

PAPER AND BOARD	
Newsprint	2,705 metric tpd
Coated publication	350 metric tpd
SC-B	200 metric tpd
Recycled board	300 metric tpd
Total	3,555 metric tpd

Longview Fibre Co.

P.O. Box 639
Longview, Wash. 98632
R.P. Wollenberg, chairman/president/chief executive officer

Net sales:	
1989	$697,725,000
1988	657,210,000
1987	569,399,000
1986	487,685,000
1985	459,058,000
Net income:	
1989	$66,519,000
1988	96,332,000
1987	65,166,000
1986	33,484,000
1985	22,418,000

(fiscal year ends Oct. 31)

Longview Fibre specializes in kraft linerboard and kraft packaging paper at its Longview, Wash., mill. About 67% of this output goes to the company's 15 converting plants in ten states. In fiscal 1989, about 89% of Longview's sales were derived from pulp, paperboard, and converting operations. Converted products accounted for the largest amount of sales—nearly 52%.

Sales of paper and board in 1989 reached $256.2 million, and converted products sales were $361.4 million.

In 1989, total primary production of paper and paperboard was 918,000 short tons. The company sold 294,000 tons of paper, 137,000 tons of paperboard, and 570,000 tons of converted products.

Capital expenditures in 1989 totaled $127.7 million. Total fiscal 1990 spending is budgeted at $120 million.

In 1988, the company authorized a $90-million project to build No. 12 paper machine over a two-year period. The 300-tpd machine will help meet customer demand for lightweight packaging papers. An additional recovery boiler at a cost of $95 million was authorized in 1989 and was also expected to take two years to complete. The unit is needed for increased pulp production and to replace a small unit, which is forty years old.

The recycling plant for old corrugated containers is in service and has been doubled in capacity, and numerous pulp mill improvements are under way. Also, an increase in capacity of the water effluent treatment plant is planned.

Longview owns 496,000 acres of timberland and has cutting rights on another 7,000 acres.

Production facilities:

LONGVIEW, WASH.
Pulp—2,760 tpd kraft; 240 tpd semichemical
Packaging, industrial converting paper—1,335 tpd
Unbleached kraft board—1,265 tpd
Semichemical board—200 tpd

Total production capacity:

PULP	
Kraft	2,760 tpd
Semichemical	240 tpd
Total	3,000 tpd

PAPER AND BOARD	
Packaging/industrial converting paper	1,335 tpd
Unbleached kraft board	1,265 tpd
Semichemical board	200 tpd
Total	2,800 tpd

Louisiana-Pacific Corp.

111 S.W. Fifth Ave.
Portland, Ore. 97204
Harry A. Merlo, chairman/president

Net sales:*	
1989	$2,009,500,000
1988	1,799,400,000
1987	1,654,200,000
1986	1,305,800,000
1985	1,074,900,000
Net income:**	
1989	$192,600,000
1988	135,200,000
1987	118,800,000
1986	62,700,000
1985	29,700,000

* Restated to reflect June 1988 spin-off of Fibreboard Corp. subsidiary.
** Before extraordinary items.

Louisiana-Pacific is a major U.S. forest products company with more than 110 building materials plants. The company's pulp sector accounted for 13% of total sales in 1989. Pulp production was 391,000 short tons, sales were $265 million, and operating profit was $89 million.

In April 1988, the company received $440 million from the federal government for timberland taken in 1978 to expand Redwood National Park. In June 1988, L-P completed the spin-off of its Fibreboard Corp. subsidiary, which is a defendent in many lawsuits alleging injury from asbestos-containing products.

Total capital expenditures in 1989 were $260 million. Of this amount, $69 million was spent on the company's pulp sector. The company expected to spend $220 million in 1990.

A $75-million project is under way to increase capacity at the Samoa, Calif., mill by 15% and to improve environmental standards. In September 1988, L-P announced that it would build a 155,000-tpy bleached chemi-thermomechanical pulp mill near Chetwynd, B.C. Construction was scheduled to be completed in late 1990.

L-P owns 1,514,000 acres of timberland and controls another 500,000 acres.

Production facilities:

KETCHIKAN, ALASKA
Pulp—600 tpd dissolving sulfite (for market)

SAMOA, CALIF.
Pulp—600 tpd bleached kraft (for market)

Total production capacity:

PULP	
Sulfite	600 tpd
Kraft	600 tpd
Total	1,200 tpd

MacMillan Bloedel Ltd.

1075 W. Georgia St.
Vancouver, B.C. V6E 3R9
R.V. Smith, president/chief executive officer

(MB is 49.9% owned by Noranda Forest Inc. It has a 50% interest in Island Paper Mills Ltd.; Noranda Forest has the other 50%.)

Net sales:	
1989	C$3,273,700,000
1988	3,273,500,000
1987	3,134,500,000
1986	2,511,700,000
1985	2,335,400,000
Net earnings:	
1989	C$246,700,000
1988	329,800,000
1987	280,600,000
1986	178,300,000
1985	32,800,000

MacMillan Bloedel is one of North America's largest forest products companies, with integrated operations in Canada, the U.S., the U.K., and continental Europe. It produces kraft pulp, newsprint, groundwood printing papers, fine papers, containerboard, corrugated containers, lumber, and panelboards. The company is emphasizing a program to reduce costs and stress new, value-added products, including groundwood papers and higher-quality newsprint.

Sales of pulp and paper reached C$1,310.2 million in 1989. Newsprint accounted for C$771.9 million; market pulp, C$460.5 million; fine papers, C$16.6 million; and recycled fiber, C$61.2 million. Containerboard and packaging contributed C$504.1 million to sales.

In 1989, MB produced 484,000 metric tons of market pulp, 991,000 metric tons of newsprint and groundwood printing papers, 400,000 metric tons of linerboard, and 294,000 metric tons of corrugating medium.

Total capital expenditures in 1989 were C$518.4 million, of which C$194.5 million was for pulp and paper operations and C$59.4 million was for containerboard and packaging.

A C$100-million project to install a 350-metric-tpd chemi-thermomechanical pulp line at the Port Alberni, B.C., mill was completed in the latter part of 1989. Also completed at Alberni was a hydrogen peroxide C$20-million bleaching facility. This dioxin-free process can bleach 315 metric tpd of mechanical pulp. In February, 1990, however, the company said it would have to discontinue its bleaching operations before 1992, when new regulations regarding chlorinated organics become effective.

At Powell River, B.C., a C$62-million upgrade of the mill's No. 10 paper machine, which includes a twin-wire conversion, was to be completed by the end of 1990.

MB owns or controls 1,600,000 hectares of timberland in North America.

Production facilities:
(Does not include Port Alberni expansion)

NANAIMO, B.C.
(Harmac Div.)
Pulp—1,015 metric tpd bleached kraft (for market)

NEW WESTMINSTER, B.C.
(Island Paper Mills Ltd., jointly owned)
Uncoated free-sheet—410 metric tpd (MB's share: 205 tpd)

PORT ALBERNI, B.C.
(Alberni Pulp & Paper Div.)
Pulp—500 metric tpd unbleached kraft (200 for market); 300 metric tpd bleached kraft; 620 metric tpd groundwood; 75 metric tpd refiner groundwood
Newsprint and/or groundwood specialty—1,090 metric tpd

POWELL RIVER, B.C.
(Powell River Div.)
Pulp—455 metric tpd kraft (90 tpd for market); 700 metric tpd groundwood; 635 metric tpd chemi-thermomechanical
Newsprint/groundwood paper—1,750 metric tpd

STURGEON FALLS, ONT.
Pulp—250 metric tpd semichemical
Corrugating medium—210 metric tpd

PINE HILL, ALA.
(MacMillan Bloedel Inc.)
Pulp—1,100 short tpd (1,000 metric) unbleached kraft; 430 short tpd (390 metric) semichemical
Linerboard—1,165 short tpd (1,055 metric)
Corrugating medium—650 short tpd (590 metric)

Total production capacity:

PULP	
Kraft	3,270 metric tpd
Semichemical	640 metric tpd
Groundwood/RMP	1,395 metric tpd
CTMP	635 metric tpd
Total	5,940 metric tpd
PAPER AND BOARD	
Newsprint/groundwood specialty	2,840 metric tpd
Uncoated free-sheet	205 metric tpd
Linerboard	1,055 metric tpd
Corrugating medium	800 metric tpd
Total	4,900 metric tpd

Macon Kraft Inc.

Box 1551
Rome, Ga. 30161
Timothy L. Campbell, president/chief executive officer

Financial data not available.

In 1987, Pratt Holdings Pty Ltd. of Australia acquired Georgia Kraft Co.'s Macon, Ga., mill from joint owners Mead Corp. and Temple-Inland Inc. A large lumber/plywood manufacturing complex and 200,000 acres of timberland were included in the purchase, but Pratt said it would sell the woodlands and wood products complex to Georgia-Pacific Corp.

The new owner announced plans in late 1987 to invest about $170 million in the mill, spread over several years.

In mid-1989, the company had plans to spend $20 million to improve quality and incrementally expand capacity from 1,700 to 2,000 tpd. The project, which includes expansion of the wastepaper recycling plant and new screening and washing equipment in the kraft pulp mill, was to be completed in late 1989/early 1990.

The company is also studying the installation of a new recovery boiler and rebuild of No. 1 linerboard machine.

Production facilities:

MACON (Krannert), GA.
Kraft linerboard—1,700 tpd

Total production capacity:

PAPERBOARD	1,700 tpd

Manville Forest Products Corp.

(Sub. of Manville Corp.)
P.O. Box 488
West Monroe, La. 71294-0488
H.W. Sherman, president

Financial data not available.

Manville Corp. filed for protection under Chapter 11 of the federal bankruptcy code in mid-1982. It emerged from bankruptcy on Nov. 28, 1988.

Approximately 80% of Manville Forest Products' sales come from pulp, paper, and paperboard products. The West Monroe, La., mill was a pioneer in developing clay-coated kraft board (solid unbleached sulfate) grades used in beverage carriers and folding cartons. In 1989, the company produced 530,000 tons of SUS. Total capacity at the end of 1989 was about 770,000 tpy.

Manville Corp. spent a record $350 million in capital spending in 1989 and is prepared to spend $300 million or more in 1990 . A recent $6.6-million rebuild of the No. 2 paper machine in West Monroe, La., has boosted operating margins, and ongoing modernization programs could increase production efficiencies of the paper mill by about 15% over the next few years. A state-of-the-art, $40-million recovery boiler system, which was to be completed in early 1990, also will increase efficiency and capacity.

Manville Forest Products owns over 776,000 acres of U.S. timberland.

Production facilities:

WEST MONROE, LA.
Pulp—1,700 tpd kraft; 270 tpd semichemical
Kraft paper—125 tpd
Paperboard—1,650 tpd
Corrugating medium—300 tpd

Total production capacity:

PULP	
Kraft	1,700 tpd
Semichemical	270 tpd
Total	1,970 tpd
PAPER AND BOARD	
Paperboard	1,650 tpd
Kraft paper	125 tpd
Corrugating medium	300 tpd
Total	2,075 tpd

Mead Corp.

Courthouse Plaza Northeast
Dayton, Ohio 45463
Burnell R. Roberts, chairman/chief executive officer

(Mead has a 50% interest in Northwood Forest Industries [with Noranda Forest Inc.].)

Net sales:	
1989	$4,612,000,000
1988	4,463,900,000
1987	4,208,800,000
1986	3,217,700,000
1985	2,740,400,000
Net earnings:	
1989	$215,800,000
1988*	364,100,000
1987	216,700,000
1986	5,800,000
1985	76,400,000

*Reflects $11.4-million loss from discontinued operations.

Mead segments include paper, packaging and paperboard, pulp and wood products, converted paper products/ distribution, and electronic publishing. The main emphasis, however, is on coated paper and paperboard, and the company has recently divested a number of operations that no longer fit its strategic plan. The purchase of Zellerbach Distribution Group in May 1986 made Mead the largest U.S. integrated distributor of paper. Fourty-four percent of total sales are derived from pulp, paper, and paperboard. Ninety-one percent are derived from these areas plus converting operations and distribution.

Mead produced 2,126,000 tons of paper and paperboard in 1989 and 1,170,000 tons of pulp (1,001,000 of which was used internally).

In spring 1988, Mead began construction of a new 370,000-tpy coated natural kraft board expansion of its Mahrt mill in Phenix City, Ala. The greenfield mill will nearly double current capacity for 430,000 tpy of coated paperboard. The $560-million project, the largest Mead has undertaken, was completed in late-1990.

Also expected to be completed in 1990 is the first phase of a quality improvement program at the Escanaba, Mich., mill.

The company has gotten more involved in color copying paper, but its new Cycolor unit was developing slowly late into 1990. The venture is not expected to break even until 1992.

Total capital spending for 1989 equaled $615.8 million. Eighty-five percent of this went to the forest products area. The company expected to spend from $550 to $600 million in 1990 and then reduce spending in 1991.

Mead owns 1,400,000 acres of timberland.

Production facilities:

PHENIX CITY (Mahrt), ALA.
(Coated Board Div.)
Pulp—1,959 tpd unbleaded kraft
Kraft packaging—1,229 tpd

STEVENSON, ALA.
(Containerboard Div.)
Pulp— 750 tpd semichemical
Corrugating medium—1,071 tpd

SOUTH LEE, MASS.
(Specialty Paper Div.)
Specialty paper—74 tpd

ESCANABA, MICH.
(Publishing Paper Div.)
Pulp—1,000 tpd kraft
257 tpd groundwood
Printing/writing paper—1,486 tpd

CHILLICOTHE, OHIO
(Fine Paper Div.—Chillicothe and Chilpaco mills)
Pulp—886 tpd kraft
Carbonless paper—457 tpd
Coated 371 tpd
Uncoated 457 tpd

KINGSPORT, TENN.
(Fine Paper Div.)
Pulp—386 tpd bleached hardwood soda
Coated 186 tpd
Uncoated 386 tpd

MENASHA, WIS.
(Gilbert Paper Co.)
Rag-content, security paper—100 tpd

PRINCE GEORGE, B.C.
(Northwood Forest Industries)
Kraft pulp—1,493 metric tpd (1,645 short)
(Mead's share: 823 short tpd)

Total production capacity:

PULP (short tons)	
Kraft	4,647 tpd
Soda	586 tpd
Semichemical	750 tpd
Groundwood	257 tpd

PAPER (short tons)	
Printing/writing	2,860 tpd
Rag-content	100 tpd
Specialty	74 tpd
Carbonless	543 tpd

PAPERBOARD (short tons)	
Corrugating medium	1,071 tpd
Natural kraft	1,314 tpd
Total	2,385 tpd

TOTAL PAPER AND BOARD 6,074 tpd
(tpd figures are derived from tpy figures based on a 350-day year— 345 for Prince George, B.C.)

The Newark Group Inc.

20 Jackson Drive
Cranford, N.J. 07016
Edward K. Mullen, chairman/chief executive officer

(California Paperboard Corp., Franklin Boxboard Corp., Haverhill Paperboard Corp., Middletown Paperboard Corp., Mobile Paperboard Corp., Natick Paperboard Corp., Newark Atlantic Paperboard Corp., Newark Boxboard Co., Newark Pacific Paperboard Corp., and Wisconsin Paperboard Corp. are all part of the Paperboard Mill Div. of The Newark Group Inc.)

Financial data not available.

In 1988, the company established Newark Pacific Paperboard Corp. within the Paperboard Mill Div. to acquire the clay-coated recycled paperboard mill of Federal Paper Board Co. at Los Angeles, Calif.

The Newark Group purchased from National Gypsum Co. a two-cylinder machine mill in Stockton, Calif., in the summer of 1989. The mill is now being operated as Newark Sierra Paperboard Corp.

In fall 1989, the company started up a second cylinder machine at the Mobile, Ala., location.

Capital expenditures for 1989 amounted to $20 million and are expected to decrease to $15 million in 1990.

Production facilities:

FRANKLIN, OHIO
(Franklin Boxboard Corp.)
Recycled paperboard—165 tpd

HAVERHILL, MASS.
(Haverhill Paperboard Corp.)
Recycled paperboard—300 tpd

LAWRENCE, MASS.
(Newark Atlantic Paperboard Corp.)
Clay-coated recycled paperboard—200 tpd

LOS ANGELES (City of Commerce), CALIF.
(Newark Pacific Paperboard Corp.)
Clay-coated recycled paperboard—165 tpd

MIDDLETOWN, OHIO
(Middletown Paperboard Corp.)
Recycled paperboard—130 tpd

MILWAUKEE, WIS.
(Wisconsin Paperboard Corp.)
Recycled paperboard—420 tpd

MOBILE, ALA.
(Mobile Paperboard Corp.)
Recycled paperboard—350 tpd

NATICK, MASS.
(Natick Paperboard Corp.)
Recycled paperboard—200 tpd

NEWARK, N.J.
(Newark Boxboard Co.)
Recycled paperboard—130 tpd

SANTA CLARA, CALIF.
(California Paperboard Corp.)
Recycled paperboard—300 tpd

STOCKTON, CALIF.
(Newark Sierra Paperboard Corp.)
Recycled paperboard—270 tpd

Total production capacity:

PAPERBOARD	
Recycled	2,630 tpd

Noranda Forest Inc.

(Subsidiary of Noranda Inc.)
Suite 4414, P.O. Box 7
Toronto Dominion Bank Tower
Toronto, Ont. M5K 1A1
Adam Zimmerman, chairman/chief executive officer

(Noranda Forest Inc. owns 100% of Fraser Inc. and James Maclaren Industries Inc., 75% of Island Paper Mills Co. [50% directly and 25% through MacMillan Bloedel Ltd.], 50% of Northwood Pulp & Timber Ltd., and 49.9% of MacMillan Bloedel [listed separately in Company Profiles]. Noranda Forest also has a 50% interest in MacMillan Bathurst Inc. [held through MacMillan Bloedel] and has acquired Normick Perron Inc., which in turn has a 42% interest in the Donohue-Normick Inc. joint-venture newsprint mill at Amos, Que.)

Net sales:	
1989	C$4,868,000,000
1988	4,715,000,000
1987	4,470,000,000
1986	3,736,000,000
1985	3,400,000,000
Net earnings:	
1989	C$207,000,000
1988	246,000,000
1987	203,200,000
1986	102,700,000
1985	(21,100,000)

Noranda Inc. established its Noranda Forest Inc. subsidiary in 1987 with the amalgamation of Fraser and James Maclaren Industries, following which the shares in MacMillan Bloedel, Northwood Pulp & Timber, and Noranda Forest Sales were transferred to the company, now freestanding.

Approximately 62% of earnings in 1989 came from pulp and paper products; another 13% came from paperboard packaging.

Noranda Forest spent C$812 million on capital outlays in 1989. Fraser's C$69-million modernization of two fine-paper machines at Madawaska, Maine, mill started up on time in December 1989. This project is intended to give Fraser a specialized market niche in lightweight book papers.

Important to Noranda Forest's long-term fiber supply strategy was the acquisition of Normick Perron Inc. in September 1989. Normick retains substantial cutting rights in Quebec and Ontario and is a major supplier of chips to Maclaren's Masson newsprint mill. Normick is the largest Canadian sawmill operator east of the Rockies, has significant panelboard manufacturing capability, and holds a 42% interest in one of Canada's lowest-cost newsprint mills, Donohue Normick Inc. of Amos, Que.

Projects that were to be completed in 1990 include the installation of an $82-million off-machine coater at the Island Paper Mills facility in Vancouver, B.C.; the modernization of the No. 10 newsprint machine at Powell River, B.C.; the $168-million, 75,000-metric-tpy output expansion at the Thurso, Que., bleached hardwood pulp mill; and the product quality improvement program at Pine Hill, Ala.

The Thorold, Ont., mill will be doubling capacity to produce 42,000 metric tpy of deinked recycled pulp at a cost of C$7 million. And over a half million dollars have been spent on a feasibility study for a new recycling facility designed to produce about 115,000 metric tpy of deinked recycled fiber.

The James Maclaren Industries mill in Masson, Que., was struck for several weeks by union workers in early Summer.

Noranda Forest expected to spend approximately C$700 million on capital expenditures in 1990, most of which is required to complete projects already in progress, with the remainder to be spent on environment-related projects.

Noranda Forest owns 1.7 million acres of timberland in North America. It also controls 9.6 million acres, which includes volume-based cutting rights as well as MacMillan Bloedel's acreage. (This does not include Normick's cutting rights.)

Production facilities:

NEW WESTMINSTER, B.C.
(Island Paper Mills Co.)
Uncoated free-sheet—350 metric tpd (Noranda Forest's share: 50% or 175 metric tpd)

ATHOLVILLE, N.B.
(Atholville Pulp Inc.)
Pulp—350 metric tpd magnesium bisulfite (for market)

EDMUNDSTON, N.B.
Pulp—304 metric tpd groundwood; 372 metric tpd bleached softwood sulfite; 463 metric tpd unbleached and semibleached sulfite (all consumed on site)
Paperboard—127 metric tpd coated and uncoated boxboard

THOROLD, ONT.
(Thorold Div.)
Pulp—59 metric tpd deinked
Coated and uncoated free-sheet—250 metric tpd

MADAWASKA, MAINE
(Fraser Inc.)
Uncoated groundwood paper—418 short tpd (379 metric)
Uncoated free-sheet—418 short tpd (379 metric)
Coated paper—430 short tpd (390 metric)

MASSON (Buckingham), QUE.
(James Maclaren Industries Inc.)
Pulp—350 metric tpd groundwood; 235 metric tpd sulfite (all consumed on site)
Newsprint—585 metric tpd

THURSO, QUE.
(James Maclaren Industries Inc.)
Pulp—380 metric tpd bleached kraft (for market)

PRINCE GEORGE, B.C.
(Northwood Pulp & Timber Ltd.)
Pulp—1,475 metric tpd bleached kraft (1,050 for market) (Noranda Forest's share: 738 metric tpd)

Total production capacity:

PULP	
Kraft	1,118 metric tpd
Sulfite	1,420 metric tpd
Groundwood	654 metric tpd
Deinked	59 metric tpd
Total	3,251 metric tpd (1,724 tpd consumed on site)

PAPER AND BOARD	
Newsprint	585 metric tpd
Printing/writing	1,573 metric tpd (including 50% of Island Paper Mills)
Paperboard	127 metric tpd
Total	2,285 metric tpd

Packaging Corp. of America

(Subsidiary of Tenneco Inc.)
1603 Orrington Ave.
Evanston, Ill. 60204
Monte R. Haymon, president/chief executive officer

Net sales:	
1989	$1,343,003,000
1988	1,304,893,000
1987	1,153,223,000
1986	953,000,000
1985	854,500,000
Operating income:	
1989	$200,000,000
1988	215,000,000
1987	166,000,000
1986	110,000,000
1985	93,000,000

Packaging Corp. of America made several acquisitions between 1985 and 1989 in order to become a full-line packaging company. About 69% of company sales come from pulp, paper, paperboard, and converted products.

Much of the containerboard produced at PCA's Counce, Tenn., and Filer City, Mich., mills is converted at the company's 26 U.S. container plants. The Molded Fibre Group operates five plants in the U.S. and three in Europe, manufacturing egg, produce, and other special trays. The Aluminum & Plastic Group produces containers from a wide variety of materials. In the fall of 1990, PCA and GE Capital acquired two containerboard mills and 19 box plants from Georgia-Pacific for $740 million.

Pulp, paper, paperboard, and converting operations accounted for sales of $925 million in 1989. Shipments (to outside customers only) of paper and board were 1.0 million tons. In addition, 10.4 million ft^2 of converted products were shipped. The company produced 1,287,000 tons of paper and paperboard and 140,000 tons of pulp in 1989.

Total capital expenditures in 1989 were $88.3 million, and spending was expected to reach $133.8 million in 1989.

PCA owns 413,000 acres and controls another 77,000 acres of forestland.

Production facilities:

MIDDLETON, CALIF.
Molded pulp products—16 tpd

RED BLUFF, CALIF.
Molded pulp products—100 tpd

MACON, GA.
Molded pulp products—85 tpd

GRIFFITH, IND.
Molded pulp products—62 tpd

TAMA, IOWA, and RITTMAN, OHIO
Recycled board—525 tpd together

FILER CITY, MICH.
Pulp—610 tpd semichemical
Corrugating medium—775 tpd

PLATTSBURGH, N.Y
Molded pulp products—45 tpd

COUNCE, TENN.
(Tennessee River Pulp & Paper Co.)
Pulp—1,650 tpd kraft
Linerboard—2,100 tpd

Total production capacity:

PULP	
Kraft	1,650 tpd
Semichemical	610 tpd
Total	2,260 tpd
PAPERBOARD	
Recycled board	525 tpd
Corrugating medium	775 tpd
Linerboard	2,100 tpd
Total	3,400 tpd

Paperboard Industries Corp.

144 Front St. West, Suite 600
Toronto, Ont. M5J 1G2
C. Ian Ross, president, chief executive officer

(Paperboard Industries Corp. was taken private in early 1988; therefore, some financial data is not available for that and the following years. Belkin Inc. was amalgamated into PIC in September of 1987.)

Net sales:	
1989	C$659,900,000
1988	577,200,000
1987*	203,749,000
1986	79,792,000
1985	71,563,000
Net earnings:	
1987*	C$3,012,000
1986	3,228,000
1985	569,000

(fiscal year ends Aug. 31)
*Includes three months of Belkin Inc. operations.

Paperboard was incorporated in 1980; in 1982, it brought together its four companies, Trent Valley Paperboard Mills being the oldest and the only paperboard manufacturer; and in 1984, PIC was organized into one legal entity. In 1986, the U.S. subsidiary, Paperboard Industries Inc., bought Big M Paperboard Inc. of Palmyra, Mich., which has boxboard capacity of 25,000 metric tpy and is strategically close to the Trent Valley operation. With the Belkin acquisition, Paperboard became a significant player in collecting wastepaper, manufacturing recycled paperboard, and converting and selling packaging products.

The Trent Valley operation consists of East Mill, over a century old, which produces boxboard on two machines, and West Mill, which dates from 1978 and makes either boxboard or linerboard on one machine.

Paperboard is Canada's largest integrated recycled paperboard manufacturer and paperboard packaging supplier, with 26 locations across Canada and five locations in the U.S.

The company has grown through the acquisitions of Belkin Inc. in May 1987, Rolph-Clark-Stone Packaging Inc. in April 1988, and Telfer Packaging Ltd. in January 1989.

Production facilities:

BURNABY, B.C.
(Former Belkin Inc. mill)
Paperboard—550 metric tpd containerboard, boxboard

TORONTO, ONT.
(Former Belkin Inc. mill)
Paperboard—410 metric tpd coated linerboard, boxboard

TRENTON (Glen Miller), ONT.
(Trent Valley Div., West and East mills)
Paperboard—330 metric tpd boxboard or linerboard

MONTREAL QUE.
(Former Belkin Inc. mill)
Paperboard—100 metric tpd boxboard, corestock

PALMYRA, MICH.
(Big M Paperboard Inc.)
Recycled paperboard—83 short tpd (75 metric)

Total production capacity:

PAPERBOARD	1,465 metric tpd

Parsons & Whittemore Inc.

666 Third Ave.
New York, N.Y. 10017
Arthur L. Schwartz, president

Financial data not available.

P&W is one of the largest privately owned companies in the North American pulp and paper industry.

In spring 1988, P&W and Abitibi-Price Inc. announced plans to jointly build a 220,000-metric-tpy newsprint mill near P&W's Alabama River Pulp Co. mill. P&W will be responsible for design and construction of the mill, and Abitibi will operate it.

P&W is spending $35 million at Alabama River Pulp in a three-year program to add 30,000 metric tpy of bleached kraft pulp capacity.

In spring 1990, P&W announced its Alabama Pine Pulp project, a 1,250-tpd pine pulp mill near Claiborne, Ala.

Production facilities:

CLAIBORNE, ALA.
(Alabama River Pulp Co.)
Pulp—1,100 tpd bleached hardwood and softwood kraft (for market)

NACKAWIC, N.B.
(St. Anne-Nackawic Pulp & Paper Co. Ltd.)
Pulp—675 metric tpd (744 short) bleached hardwood kraft (for market)

Total production capacity:

PULP	1,844 short tpd

Pentair Inc.

1700 W. Highway 36
St. Paul, Minn. 55113
D. Eugene Nugent,
chairman/president/chief executive officer

(Wholly owned subsidiaries are Niagara of Wisconsin Paper Corp. and Cross Pointe Paper Corp. Lake Superior Paper Industries is a 50:50 joint venture with Minnesota Power.)

Net sales:*	
1989	$1,163,627,000
1988	823,281,000
1987	789,245,000
1986	623,876,000
1985	534,198,000
Net income:*	
1989	$36,407,000
1988	39,842,000
1987	21,860,000
1986	15,228,000
1985	20,058,000
Net sales, paper sector:	
1989	$365,252000
1988	378,300,000
1987	387,000,000
1986	377,800,000
1985	363,600,000
Operating income, paper sector:	
1989	$36,000,000
1988	50,500,000
1987	9,000,000
1986	18,400,000
1985	22,800,000
1984	37,300,000

*Does not include sales from Lake Superior Paper Industries.

Formed in 1966, Pentair has grown through acquisitions of inefficient operations that it turns into autonomous, profitable subsidiaries. The company focuses on higher-value printing/writing and publications papers. In 1987 it sold off two specialty papers mills that it bought from Port Huron Paper Corp. in 1983.

In mid-1988, Pentair combined Miami Paper and Flambeau Paper under the name Cross Pointe Paper Corp. The Lake Superior Paper Industries mill, which came online in late 1987, is the first mill Pentair has been involved in building. The $400-million, 240,000-tpy joint venture between Pentair Duluth Corp. (subsidiary of Pentair Inc.) and Minnesota Paper Inc. (subsidiary of Minnesota Power) gave Pentair entry into the fast-growing supercalendered paper market.

Pulp and paper accounted for 35% of net sales in 1989. Among the company's wholly owned subsidiaries, 460,000 tons of paper and 180,000 tons of pulp were produced in 1989. LSPI produced 150,000 tons of paper and 70,000 tons of pulp.

The company spent $83.4 million in 1989 on capital projects, 55% of which went toward pulp and paper operations. Total capital spending in 1990 was expected to be $75 million. Niagara of Wisconsin Paper built a $38-million pressurized groundwood pulp mill.

Production facilities:

DULUTH, MINN.
(Lake Superior Paper Industries)
Pulp—315 tpd pressurized groundwood
Supercalendered paper—620 tpd

WEST CARROLLTON, OHIO
(Cross Pointe Paper Corp.)
Pulp—160 tpd deinked
Fine papers—300 tpd (uncoated free-sheet)

NIAGARA, WIS.
(Niagara of Wisconsin Paper Corp.)
Pulp—280 tpd pressurized groundwood
Printing/publication papers—650 tpd (coated groundwood)

PARK FALLS, WIS.
(Cross Pointe Paper Corp.)
Pulp—170 tpd sulfite
Fine papers—360 tpd (uncoated free-sheet)

Total production capacity:

PULP	
Deinked	160 tpd
Groundwood	595 tpd
Sulfite	170 tpd
Total	925 tpd
PAPER	
Printing/publication	650 tpd
Fine	660 tpd
Supercalendered	620 tpd
Total	1,930 tpd

Pope & Talbot Inc.

1500 S.W. First Ave.
Portland, Ore. 97201
Peter T. Pope, chairman/president/chief executive officer

Net sales (revenues):	
1989	$618,758,000
1988	514,980,000
1987	426,908,000
1986	310,228,000
1985	325,203,000
Net income:	
1989	$43,637,000
1988	31,944,000
1987	28,129,000
1986	15,815,000
1985	6,648,000

Pope & Talbot has two businesses: wood products and pulp and paper products. Accounting for 62% of company sales, the pulp and paper segment produces bleached kraft pulp, tissue products, and diapers. Recent acquisitions and construction support the company's long-term goal to produce private-label and generic tissue and disposable diapers at low-cost facilities.

In 1989, pulp and paper products contributed $384.6 million in sales and $55.6 million in operating profit. Production of bleached softwood pulp in 1989 was 198,000 tons, and output of consumer tissue products was 136,000 tons.

Total 1989 capital expenditures were $52.1 million, which includes $29.3 million for pulp and papermaking facilities.

In August 1988, the company purchased four disposable diaper plants from Georgia-Pacific Corp. It also completed construction on a new diaper facility near Atlanta, Ga. Pope & Talbot is studying a possible expansion of the Halsey, Ore., pulp mill that would increase annual capacity from 200,000 tons to 515,000 tons.

Pope & Talbot owns 37,000 acres of timberland in the U.S.

Production facilities:

HALSEY, ORE.
(Pope & Talbot Pulp Inc.)
Pulp—557 tpd bleached softwood and hardwood kraft (for market)

RANSOM, PA.
(Absorbent Products Div.)
Pulp—150 tpd deinked
Tissue—135 tpd

EAU CLAIRE, WIS.
(Absorbent Products Div.)
Pulp—225 tpd deinked
Paper—180 tpd tissue, towel

LADYSMITH, WIS.
(Absorbent Products Div.)
Pulp—50 tpd deinked
Paper—85 tpd tissue, wadding

Total production capacity:

PULP	
Bleached kraft	557 tpd
Deinked	425 tpd
Total	982
PAPER	
Tissue	400 tpd

Potlatch Corp.

One Maritime Plaza
San Francisco, Calif. 94111
Richard B. Madden, chairman/president/chief executive officer

Net sales:	
1989	$1,227,622,000
1988	1,084,000,000
1987	992,077,000
1986	976,373,000
1985	950,323,000
Net earnings:	
1989	$136,715,000
1988	112,364,000
1987	87,623,000
1986	69,943,000
1985	37,669,000

Potlatch is a diversified forest products company that makes bleached pulp, paperboard, and packaging; coated free-sheet paper; private-label tissue; and lumber and panel products. The company emphasizes high-value-added products that are less vulnerable to economic cycles. Of total sales, about 75% is derived from pulp, paper/paperboard, and converted products.

Paper sales in 1989 reached $366.3 million; pulp and paperboard sales were $406.8 million; and tissue sales were $117.0 million.

Potlatch has capacity for 865,700 tpy of bleached kraft pulp, 560,300 tpy of bleached paperboard, 310,700 tpy of printing paper, and 83,200 tpy of tissue and toweling. Pulp output in 1989 was about 863,000 tons. Total paper/paperboard production was approximately 943,000 tons: 297,000 tons of printing paper, 86,000 tons of tissue, and 560,000 tons of paperboard.

Capital expenditures totaled $142.7 million in 1989. About $107.3 million of that amount was spent on pulp and paper operations.

In April 1988, a 100,000-tpy free-sheet machine was started up at the Cloquet, Minn., mill to produce 100% coated paper, and a $28-million off-machine coater was installed at the mill in 1989. The company is also studying a pulp capacity increase of 100% at Cloquet.

A new recovery boiler and evaporator added over 150 tpd of pulp capacity at Lewiston, Idaho. Approximately $333.0 million was budgeted to be spent in 1990. About one-third of these 1990 expenditures relate to the pulp mill modernization, multi-ply forming equipment, and new turbine generator in Lewiston. New projects include an expansion of the tissue mill in Lewiston.

Potlatch owns 1.5 million acres of timberland in Arkansas, Idaho, and Minnesota.

Production facilities:

McGEHEE, ARK.
(Cypress Bend Pulp Mill)
Pulp—582 tpd bleached kraft (small amount for market)
Bleached paperboard—638 tpd

LEWISTON, IDAHO
(Paperboard Div.)
Pulp—1,345 tpd bleached kraft (some for market)
Bleached paperboard—940 tpd

LEWISTON, IDAHO
(Consumer Products Div.)
Tissue—234 tpd

BRAINERD, MINN.
(Northwest Paper Div.)
Printing paper—366 tpd

CLOQUET, MINN.
(Northwest Paper Div.)
Pulp—511 tpd bleached kraft
Printing paper—509 tpd

Total production capacity:

PULP	2,438 tpd
PAPER AND BOARD	
Printing	875 tpd
Tissue	234 tpd
Paperboard	1,578 tpd
Total	2,687 tpd

Procter & Gamble Co.

One Procter & Gamble Plaza
Cincinnati, Ohio 45202
Richard R. Nicolosi, vice president, P&G Paper Products
R.E. Cannon, group vice president, P&G Cellulose

(Wholly owned subsidiaries include Procter & Gamble Paper Products Co. and Procter & Gamble Cellulose)

Financial data for P&G's papermaking operations not available.

P&G first entered the pulp and paper business through construction of its Foley, Fla., pulp mill in 1951. In 1957, P&G acquired a company with two tissue mills in the Midwest. It was renamed Charmin Paper and expanded into a national producer with the addition of mills at Mehoopany, Pa. (built in 1966); Oxnard, Calif. (acquired from International Paper in 1974); and Albany, Ga. (built in 1971). The company backed its expansion into tissue with an aggressive marketing program and the development of superior products. Charmin was the first producer to commercialize through-air predrying of tissue paper, a technology that offers improved softness and absorbency.

The company first entered the disposable diaper market in 1961 when it began to test market its Pampers brand in Peoria, Ill. This brand, along with the Luvs premium diaper introduced in 1976, helped P&G establish a significant position in the disposable diaper market. The company's share, however, has declined from over 70% in the 1970s to about 53% in the first half of 1987. P&G is meeting the challenge in this highly competitive market by introducing product improvements in Ultra Pampers Plus and Luvs Deluxe. The gender-specific Luvs Deluxe was introduced nationally in November 1988 as the latest technology to prevent leakage and improve fit.

The company's tissue mills and diaper converting plants are supplied with pulp by its Foley, Fla., Grand Prairie, Alta., and Oglethorpe, Fla., pulp mills (the last built in 1981). In mid-1986, P&G announced it would phase out ammonia-based sulfite pulp production at the Fox River mill in Green Bay, Wis. Pulp for its tissue mills would come from the Alberta facility.

In early 1990 P&G announced plans for a major expansion of its toilet tissue and paper towel business in the U.S. The company has authorized funds to increase the output of its existing mills and plans to build at least one new paper machine. Options under consideration include adding a new paper machine at Oxnard, Calif., or building a new West Coast facility. A date for completion has not been set, but the company is planning on spending at least $100 million on the project.

Also in 1990, P&G and Wisconsin Public Service Corp. reached an agreement on electric power sales that in 1992 will result in a $33-million, natural-gas-fired, 45-MW cogeneration plant at P&G's Fox River mill in Green Bay, Wis. A C$365-million expansion of the company's Grande Prairie, Alta., bleached kraft market pulp mill was put on hold for at least two years because of environmental studies.

Production facilities:
(Procter & Gamble does not release capacity figures; the following are estimates.)

OXNARD, CALIF.
(Procter & Gamble Paper)
Tissue grades

FOLEY (Perry), FLA.
(Buckeye Cellulose Corp.)
Pulp—1,335 tpd dissolving, fluff, and paper-grade kraft

ALBANY, GA.
(Procter & Gamble Paper)
Tissue grades—500 tpd

OGLETHORPE, GA.
(Buckeye Cellulose Corp.)
Pulp—860 tpd bleached kraft (mainly fluff pulp)

CHEBOYGAN, MICH.
(Procter & Gamble Paper)
Tissue grades—60 tpd

MEHOOPANY, PA.
(Procter & Gamble Paper)
Pulp—sulfite
Tissue grades—750 tpd

MEMPHIS, TENN.
(Buckeye Cellulose Corp.)
Pulp—265 tpd cotton linters

GREEN BAY, WIS.
(Procter & Gamble Paper: East River & Fox River mills)
Pulp—650 tpd sulfite
Tissue grades—1,000 tpd

GRANDE PRAIRIE, ALTA.
(Procter & Gamble Cellulose Ltd.)
Pulp—840 metric tpd (925 short) bleached kraft (partly for market)

Total production capacity:

PULP (short tons)	
Cotton linters	265 tpd
Kraft	3,120 tpd
Sulfite	650 tpd
Total	4,035 tpd
PAPER	
Tissue	2,570 tpd

Quebec & Ontario Paper Co. Ltd.

80 King St., 8th floor
St. Catharines, Ont. L2R 7G2
John E. Houghton, chairman/chief executive officer

(Quebec & Ontario Paper Co. Ltd. and its QNS Paper Co. Ltd. subsidiary are owned by Chicago-based Tribune Co.)

Net sales:	
1988	C$584,409,000
1987	513,712,000
1986	528,176,000
1985	503,876,000
1984	467,611,000
Net income:	
1988	C$74,176,000
1987	67,345,000
1986	31,820,000
1985	33,443,000
1984	7,904,000

Q&O manufactures newsprint and operates one of the largest newspaper recycling programs in Canada. In its quest to become a high-quality, low-cost producer, the company is reducing its number of pulping systems. For example, the Thorold, Ont., mill used four different pulping systems in 1986 and only two in 1988, and the Baie Comeau, Que., mill went from three to two in 1990.

Newsprint output in 1989 reached 730,000 metric tons.

Capital expenditures were $124 million in 1989. A 600-metric-tpd thermomechanical pulp mill at Baie Comeau, Que., replacing the sulfite pulping operation, began initial production in early 1990. The plant was expected to be fully operational by second-quarter 1990, at which time the sulfite pulping process was to be eliminated.

A new flotation deinking plant at the Thorold mill reached its planned capacity in early 1988. But labor trouble at the mill surfaced in 1990 when the CPU struck in August. An earlier strike interrupted production at the Baie Comeau, Que., newsprint mill.

Q&O owns 263,000 acres of timberlands in Canada and controls another 6,185,000 acres.

Production facilities:

THOROLD, ONT.
Pulp—500 metric tpd thermomechanical; 465 tpd deinked news
Newsprint—803 metric tpd

BAIE COMEAU, QUE.
(QNS Paper Co. Ltd.)
Pulp—600 metric tpd thermomechanical; 395 metric tpd groundwood
Newsprint—1,259 metric tpd

Total production capacity:

PULP	
Groundwood	395 metric tpd
TMP	1,100 metric tpd
Deinked news	465 metric tpd
Total	1,960 metric tpd
PAPER	
Newsprint	2,062 metric tpd

Repap Enterprises Inc.

1150 Peel Street, Suite 3200
Montreal, Que. H3B 4V9
George S. Petty, chairman/chief executive officer

Net sales:	
1989	C$1,104,600,000
1988	1,028,000,000
1987	927,000,000
1986	635,500,000
1985	429,300,000
Net earnings:	
1989	C$93,100,000
1988	92,800,000
1987	62,500,000
1986	13,000,000
1985	2,800,000

Specializing in the production of high-quality coated paper for magazines and advertising materials and of softwood kraft pulp, Repap operates four major production entities in Canada and the U.S.: Miramichi Pulp & Paper Inc. in New Brunswick, Skeena Cellulose Inc. in Northern British Columbia, Midtec Paper Corp. in Wisconsin, and, more recently, Repap Manitoba in The Pas, Man. In May 1989, Repap acquired all the outstanding shares of Repap Manitoba (formerly Manfor Ltd.).

In 1989, Repap had the capacity to produce approximately 680,000 metric tpy of kraft pulp and 972,000 short tpy of coated paper. Actual production in 1989 totaled 576,000 metric tpy of kraft pulp and 674,000 short tons of paper. Repap also has capacity for about 165,000 metric tpy of groundwood pulp. Production of this in 1989 totaled110,000 metric tpy.

Repap spent C$653 million on capital expenditures in 1989 and expected to spend C$301 million in 1990.

Construction began on a $100-million environmental program at the Skeena mill in 1989 to improve the quality of water and air effluents. The project was expected to be completed in 1990. The startup phase of Miramichi's A-2 Coated Paper Complex in Newcastle, N.B., also was to be completed in 1990, as was construction of a new chemical recovery boiler and turbo generator there.

Repap has acquired the rights to the Alcell pulping process for making hardwood pulp. Alcell uses alcohol instead of sulfur, and it has the potential for small-scale "mini-mills." These mini-mills could be built more cheaply than conventional large-scale kraft mills and could be located closer to forest areas and/or paper mills. Although developed for hardwood pulping, Alcell will probably be adapted to produce softwood pulps as well. The first Alcell commercial-size trial plant was constructed at Miramichi at a cost of C$70 million and started up in March 1989. Work has begun on the design parameters for a 300-metric-tpd production unit.

Repap holds forest licenses to 16 million acres of prime timber resources, 1.8 million acres supplying the Miramichi operations, and 1.9 million acres supplying the Skeena operations.

Production facilities:

KIMBERLY, WIS.
(Midtec Paper Corp.)
Pulp—120 metric tpd groundwood
Coated paper—1,210 metric tpd

NELSON-MIRAMICHI, N.B.
(Miramichi Pulp & Paper Inc.)
Pulp—400 metric tpd groundwood

NEWCASTLE, N.B.
(Miramichi Pulp & Paper Inc.)
Pulp—528 metric tpd kraft
Coated paper—1,242 metric tpd

WATSON ISLAND, B.C.
(Skeena Cellulose Inc.)
Pulp—1,400 metric tpd bleached kraft (for market)

Total production capacity:

PULP	
Groundwood	520 metric tpd
Kraft	1,928 metric tpd
Total	2,448 metric tpd
PAPER	
Coated	2,452 metric tpd

Rock-Tenn Co.

Box 4098
Norcross, Ga. 30091
A.W. Brown, chairman
Bradley Currey, Jr., president

Financial data not available.

A privately held company, Rock-Tenn had net sales in 1989 of $516 million—up 17% from sales of $442 million in 1988.

Between 1979 and 1989, the company acquired seven recycled board mills and 28 converting plants with an annual production of 400,000 tons. Rock-Tenn also has converting and distribution facilities for container, folding carton, solid fiber partition, fiber drum, specialty items such as book cover and furniture parts, and plastic products.

Production facilities:

EATON, IND.
Paperboard—140 tpd chipboard

OTSEGO, MICH.
(Former Mead Corp. mill)
Recycled board—230 tpd

CINCINNATI, OHIO
(Former Mead Corp. mill)
Recycled board—130 tpd

DELAWARE WATER GAP, PA.
Paperboard—130 tpd boxboard, clay-coated board

CHATTANOOGA, TENN.
Recycled paperboard—350 tpd

DALLAS, TEXAS
Recycled paperboard—415 tpd

LYNCHBURG, VA.
(Former Mead Corp. mill)
Recycled board—385 tpd

Total production capacity:

PAPERBOARD	1,780 tpd

Scott Paper Co.

Scott Plaza
Philadelphia, Pa. 19113
Philip E. Lippincott, chairman/chief executive officer

(Scott Maritimes Ltd. is a wholly owned subsidiary. In 1986, Scott bought Bowater Industries plc's 50% ownership of Bowater-Scott Corp. Ltd. in a move to strengthen its European operations, and it renamed the unit Scott Paper Ltd.)

Net sales:	
1989*	$5,065,600,000
1988**	4,726,400,000
1987	4,122,000,000
1986	3,437,000,000
1985	3,049,500,000
Net income:	
1989*	$375,500,000
1988**	400,900,000
1987	233,800,000
1986	186,500,000
1985	201,100,000

*Reflects the sale of timberlands in Washington State.
**Reflects sale of Brunswick Pulp & Paper Co.

Scott has honed its operations to two main segments: personal care and cleaning products and coated printing and publishing papers. It is the world's leading manufacturer of sanitary tissue paper products, and the S.D. Warren subsidiary is one of the largest producers of coated free-sheet in the U.S., with capacity for over 800,000 tpy. Warren also makes uncoated free-sheet and specialty grades such as release papers and pressure-sensitive labels.

Sales by the personal care/cleaning segment were $3,783.3 million in 1989; sales by the printing/publishing papers segment were $1,282.3 million. Scott Paper Ltd. reported net sales of C$436.0 million and net income of $18.0 million in 1989.

Capital expenditures were $790.6 million in 1989 and $508.7 million in 1988. Capital spending for 1990 and 1991 is expected to total about $1.5 billion.

Because of growing personal income and stronger economies in other countries, the personal care/cleaning segment, operated by Scott Worldwide, is expanding its global marketing. It launched a $250-million capital investment program in Europe in 1987, and in 1988 it announced a $50-million program for the Pacific region.

In 1989, Scott Worldwide announced plans for a tissue expansion program. The initial elements of this program include rebuilding and starting up an idle paper machine at the Chester, Pa., mill and selecting and eventually constructing a new mill for paper manufacturing and converting.

S.D. Warren is expanding production of lightweight coated papers, hoping to cash in on the growth of catalogs and specialty magazines. In late 1988, it announced a $475-million program to build a third lightweight coated paper machine at the Somerset mill at Skowhegan, Maine, and to rebuild a large heavyweight coated paper machine at Muskegon, Mich. Startup of the Somerset machine, which will increase capacity at the mill by approximately 50%, was scheduled for late 1990.

In addition, Scott is refocusing its pulp strategy on eucalyptus, northern softwood kraft, and recycled fibers. In 1988, it purchased, with two other firms, a pulp mill in Chile and 80,000 acres of forestland for growing eucalyptus trees. In 1989, Scott sold 194,000 acres of timberlands in western Washington State to Crown Pacific Ltd.

Workers at the Crabtree and Hull, Que., tissue mills achieved labor contracts that lifted wages by a whopping 19.1% over three years, a deal that surpassed the 1990 pattern labor agreement in Canada.

Scott owns 2.7 million acres of timberlands in North America.

Production facilities:
(Scott does not release capacity data; information below is estimated and incomplete.)

MOBILE, ALA.
(Southern Operations)
Pulp—1,450 tpd kraft; also deinked
Tissue—750 tpd
Uncoated free-sheet—498 tpd
Coated free-sheet—248 tpd
Cotton-fiber—99 tpd

SKOWHEGAN (Hinckley), MAINE
(S.D. Warren Div., Somerset Mill)
Pulp—900 tpd bleached kraft (300 for market)
Coated free-sheet—1,289 tpd

WESTBROOK, MAINE
(S.D. Warren Div.)
Pulp—295 tpd bleached kraft
Uncoated free-sheet—100 tpd
Coated free-sheet—347 tpd

WINSLOW, MAINE
(S.D. Warren Div.)
Pulp—485 tpd sulfite (pulp mill idle)
Tissue, toweling, waxing, coating-base, specialty—580 tpd
Uncoated free-sheet—100 tpd

MUSKEGON, MICH.
(S.D. Warren Div.)
Pulp—250 tpd bleached kraft
Coated free-sheet—397 tpd

FORT EDWARD, N.Y.
Tissue—180 tpd

CHESTER, PA.
Tissue—1,060 tpd

EVERETT, WASH.
(Northwest Operations)
Pulp—525 tpd sulfite; 30 tpd groundwood
Tissue, towel—600 tpd

MARINETTE, WIS.
Tissue—350 tpd
OCONTO FALLS, WIS. (Mill idle)
Toweling

NEW WESTMINSTER, B.C.
(Scott Paper Ltd.)
Pulp—85 metric tpd (94 short) groundwood
Tissue—300 metric tpd (330 short)

ABERCROMBIE POINT, N.S.
(Scott Maritimes Ltd.)
Pulp—600 metric tpd (662 short) bleached kraft (some for market)

CRABTREE, QUE.
(Eastern Mfg. Div.)
Pulp—90 metric tpd (92 short) deinked
Tissue—100 metric tpd (110 short)

LENNOXVILLE, QUE.
(Eastern Mfg. Div.)
Pulp—45 metric tpd (50 short) deinked
Tissue—45 metric tpd (50 short)

Total production capacity:

PULP (short tons)	
Kraft	3,557 tpd
Sulfite	1,010 tpd
Groundwood	124 tpd
Deinked	142 tpd
Total	4,833 tpd

PAPER (short tons)	
Tissue grades	4,010 tpd
Uncoated free-sheet	698 tpd
Coated free-sheet	2,281 tpd
Cotton-fiber	99 tpd
Total	7,088 tpd

Simpson Paper Co.

(Sub. of Simpson Investment Co.)
One Post St.
San Francisco, Calif. 94104
John Fannon, president

Financial data not available.

Simpson has grown through acquisitions. In late 1985, it purchased Champion International's unbleached pulp, paper, and linerboard mill at Tacoma, Wash., thus marking a diversification from its white paper and market pulp operations. The mill integrated into Simpson's timber operations, bringing with it 240,000 acres of timberland.

In late 1987, Simpson bought Chesapeake's Plainwell, Mich., mill to boost its output of premium coated printing papers at a site serving eastern markets.

In early 1987, the company bought Champion's coated and uncoated printing/writing papers mill at Pasadena, Texas. And in 1989, Simpson approved an $80-million expansion project to boost capacity there by 25%. Startup is scheduled for early 1991.

Simpson closed its Middletown, Ohio, rag-content paper facility in April 1990.

Production facilities:

ANDERSON, CALIF.
Pulp—230 metric tpd bleached kraft
Printing/writing paper—420 tpd

FAIRHAVEN, CALIF.
Pulp—625 metric tpd bleached kraft (470 for market)

POMONA, CALIF.
Pulp—60 metric tpd deinked
Printing/writing paper—340 tpd

RIPON, CALIF.
Printing/writing paper—20 tpd
Fine papers—70 tpd

PLAINWELL, MICH.
(Simpson Plainwell Paper Co.)
Printing/writing paper—155 tpd
Release liner paper—110 tpd

VICKSBURG, MICH.
Fine papers—80 tpd
Special industrial paper—20 tpd

MIQUON, PA.
Fine papers—130 tpd

PASADENA, TEXAS
(Simpson Pasadena Paper Co.)
Pulp—725 metric tpd bleached kraft
Printing/writing papers—740 tpd

TACOMA, WASH.
Pulp—1,060 metric tpd bleached/unbleached kraft (245 for market)
Paper/board—880 tpd bag, multiwall, converting, linerboard

Total production capacity:

PULP	
Kraft	2,640 metric tpd
Deinked	60 metric tpd
Total	2,700 metric tpd

PAPER AND BOARD	
Printing/writing	1,675 tpd
Fine paper	280 tpd
Release liner paper	110 tpd
Special industrial	20 tpd
Paper/board	880 tpd

Sonoco Products Co.

North Second St.
Hartsville, S.C. 29550-0160
Charles W. Coker, president

Net sales:	
1989	$1,655,830,000
1988	1,599,751,000
1987	1,312,052,000
1986	963,796,000
1985	869,598,000
Net income:	
1989	$103,561,000
1988	96,277,000
1987	61,482,000
1986	54,676,000
1985	49,409,000

Sonoco is a major manufacturer of packaging products and the world's leading producer of tubes, cores, cones, and uncoated cylinder paperboard. It produces composite cans, fiber drums and partitions, corrugating medium, and other packaging items. It is also one of the world's leading consumers of wastepaper.

Sonoco stresses vertical integration but grows through acquisitions. In 1987, it purchased Boise Cascade Corp.'s Consumer Packaging Div. (composite cans). In 1988, it bought Federal Paper Board Co.'s recycled boxboard mill at Richmond, Va., which increased Sonoco's recycled paperboard capacity to about 715,000 tpy and made it the largest U.S. producer of this grade.

The U.S. paper sector accounted for $269 million in sales in 1989—16% of the company total. Canadian results are included with the international segment, which had sales of $288 million in 1989.

Sonoco produced about 689,000 tons of uncoated cylinderboard in the U.S. in 1989, which was nearly at capacity. The Hartsville, S.C., mill produced about 156,000 tons of corrugating medium.

Capital spending in 1989 was about $110 million, not including acquisitions. Of this amount, $13 million was spent on the U.S. paper sector, and $37 million was spent on international operations including Canada.

Sonoco owns 20,000 acres of timberland and controls an additional 24,000 acres.

Production facilities:

CITY OF INDUSTRY, CALIF.
Paperboard—75 tpd

ATLANTA, GA.
Paperboard—130 tpd
ROCKTON, ILL.
Paperboard—70 tpd

HOLYOKE, MASS.
Paperboard—235 tpd

AMSTERDAM, N.Y.
Paperboard—57 tpd

LANCASTER, OHIO
Paperboard—95 tpd

MUNROE FALLS, OHIO
Paperboard—75 tpd

DOWNINGTOWN, PA.
Paperboard—170 tpd

HARTSVILLE, S.C.
Pulp—250 tpd semichemical
Corrugating medium—490 tpd
Paperboard—550 tpd

NEWPORT, TENN.
Paperboard—290 tpd

RICHMOND, VA.
(Former Federal Paper Board Co. mill)
Recycled board—200 tpd

SUMNER, WASH.
Paperboard—95 tpd

BRANTFORD, ONT.
(Sonoco Ltd.)
Paperboard—135 metric tpd (149 short)

TERREBONNE, QUE.
(Sonoco Ltd.)
Paperboard—48 metric tpd (53 short)

Total production capacity:

PULP (short tons)	250 tpd (consumed on site)
PAPERBOARD (short tons)	
Paperboard	2,244 tpd
Corrugating medium	490 tpd
Total	2,734 tpd

Southeast Paper Mfg. Co.

Box 1169
Dublin, Ga.
Robert F. Wilson, president

(Southeast is owned equally by Knight-Ridder Inc., Cox Enterprises Inc., and Media General Corp. Media General also owns Garden State Paper Co. Inc.)

Financial data not available.

In 1989, Southeast had net sales of $125.0 million, an increase from $112.5 million in 1988. The company produced 265,237 short tons of newsprint.

The company's capital expenditures in 1989 reached $182.1 million, but the company predicted spending of only $4.4 million in 1990.

In 1989, Southeast completed a $330-million expansion program more than doubling its newsprint capacity to 460,000 tpy. Plans included new deinking facilities and expanded wastepaper reclamation capacity to provide furnish for the new machine. Southeast uses Garden State Paper Co. technology in producing newsprint from recycled newspapers.

Production facilities:

DUBLIN, GA.
Pulp—600 tpd deinked; 50 tpd thermomechanical (not operated full time)
Newsprint—620 tpd

Total production capacity:

PULP	
Deinked	600 tpd
TMP	50 tpd
Total	650 tpd
PAPER	620 tpd

St. Joe Paper Co.

1650 Prudential Drive, Suite 400
Jacksonville, Fla. 32207
J.C. Belin, chairman/chief executive officer

(St. Joe Paper Co. is part of St. Joe Forest Products Co., which in turn is part of St. Joe Industries Inc., one of the two operating divisions created when the company reorganized in 1986. [The other is St. Joe Properties Inc.] St. Joe Forest Products also includes St. Joe Container and St. Joseph Land & Development Co.)

Net sales and operating revenues:	
1989	$639,337,000
1988	650,054,000
1987	596,304,000
1986	508,277,000
1985	483,000,000
Net income:	
1989	$67,241,000
1988	82,671,000
1987	57,194,000
1986	100,395,000
1985	44,000,000

St. Joe has operations in five industries: forest products, rail transport, sugar cane production and processing, communications, and real estate.

Using timber from its land holdings, the forest products division, St. Joe Forest Products Co., produces nearly 500,000 tons of bleached linerboard and kraft paperboard each year at its Port St. Joe mill, which is used to produce corrugated boxes at the company's 17 container plants. Total 1989 revenue in this division was $385.5 million, and its operating profit was $38.2 million. The company spent a total of $109.7 million on capital improvements in 1989, and $53.0 million of that amount was dedicated to forest products.

The company has adopted a four-year $207-million capital expenditure program for its St. Joe mill, including approximately $130 million in outlays to modernize equipment, improve environmental compliance, and implement new processes to further increase capacity and enhance the company's ability to produce high-performance, lighter-weight linerboard. The project is expected to boost production at the mill to 1,600 tpd by the end of 1993, up 200 tpd from current capacity.

St. Joe owns 1.1 million acres of timberland in Florida and Georgia.

Production facilities:

PORT ST. JOE, FLA.
Kraft linerboard—1,425 tpd

Total production capacity:

PAPERBOARD	1,425 tpd

Stone Container Corp.

150 N. Michigan Ave.
Chicago, Ill. 60601-7568
Roger W. Stone, chairman/president/chief executive officer

(Stone Container acquired Consolidated-Bathurst for C$2.7 billion in March 1989. Con-Bath was renamed Stone-Consolidated Inc. on Sept. 1, 1989, and it was given a world product mandate over production and marketing of both companies' newsprint, groundwood specialties, and market pulp operations. As part of the acquisition of Stone-Consolidated, Stone Container acquired a 25% interest in Celgar Pulp Co., which operates a market pulp mill in British Columbia. The merger creates the second-largest pulp, paper, and paperboard producer in the world, with sales of more than US$5 billion and capacity of approximately 8 million short tpy. The listing below includes Stone Consolidated's earnings starting Mar. 1, 1989.)

Net sales:	
1989	$5,329,700,000
1988	3,742,489,000
1987	3,232,919,000
1986	2,032,325,000
1985	1,229,148,000
Net income:	
1989	$285,800,000
1988	341,786,000
1987	161,324,000
1986	35,415,000
1985	3,778,000

Stone Container has grown from a second-tier player to the largest producer of containerboard and kraft paper in the U.S. through a series of acquisitions. It took advantage of the earlier industry downturn to acquire other companies at favorable prices using leveraged financing. The company held back on capital spending and used the strong cash flow generated by the 1986-87 industry recovery to reduce debt. In the future, however, the company may face significant capital outlays to modernize some of its higher-cost mills.

In 1989, sales reached $4.0 billion for paperboard and paper packaging and $1.1 billion for white paper and pulp. Pulp, paper/board, and converted products accounted for about 97% of the company's total sales.

Production in 1989 totaled 6.7 million tons and breaks down as follows: containerboard, 3.9 million tons; kraft paper, 634,000 tons; boxboard and other paperboard, 95,000; newsprint, 1.1 million tons; groundwood specialty papers, 319,000 tons; and market pulp, 631,000 tons. Capital expenditures in 1989 were $501.7 million, and the company expected to spend $550 million in 1990.

In 1989, in an effort to further its presence in North America, Stone Container acquired a 49% equity interest in Empaques de Carton Titan, SA, one of Mexico's largest manufacturers of corrugated containers and molded cellulose products.

As of Sept. 30, 1989, Stone Savannah River Pulp & Paper Corp. became a consolidated subsidiary. A major expansion project scheduled for completion in 1991 is under way and expected to cost $345 million. The project is designed to add about 261,000 tpy of market pulp capacity to the mill and reduce the manufacturing costs associated with the existing production of linerboard.

Stone Container increased its equity ownership of Seminole Kraft Corp., which operates a linerboard and kraft paper mill in Jacksonville, Fla., in September 1989. As a result, that company also became a consolidated subsidiary of Stone Container. In January 1990, Stone Container announced plans for a $100-million, 30-month project to convert the Jacksonville mill entirely to the production of recycled containerboard.

Stone Container increased its ownership in Stone Forest Industries from 49% to 100% in October 1989. Stone Forest Industries Inc. was formed in 1988 to acquire Stone Container Corp.'s forest products operations, including 334,000 acres of private-fee timberland included in the 1987 purchase of Southwest Forest Industries, plus plywood, veneer, and lumber plants.

The Canadian unit, Stone-Consolidated, was chosen by the Canadian Paperworkers Union as the 1990 "target" company, in order to establish a pattern contract for most eastern Canadian workers. After some hard bargaining, both sides hammered out a three-year pact that lifted wages 16.5%, but allowed the company to operate its mills on two statutory holidays and allowed greater flexibility in assigning tasks.

Stone Container owns 171,743 acres of timberlands in the U.S. and 337,000 acres in Canada, and it controls another 1.7 million acres in the U.S. and 11.4 million acres in Canada.

Production facilities:
(Figures for some production facilities are not available.)

UNCASVILLE, CONN.
Corrugating medium—230 tpd

JACKSONVILLE, FLA.
(Seminole Kraft Corp.)
Pulp—1,470 tpd bleached kraft (Stone's share: 882 tpd)
Linerboard—1,084 tpd (Stone's share: 650 tpd)
Kraft paper—347 tpd (Stone's share: 208 tpd)

PORT WENTWORTH, GA.
Pulp—800 tpd unbleached kraft
Linerboard—981 tpd

HODGE, LA.
Pulp—1,400 tpd unbleached kraft; 300 tpd semichemical
Kraft papers—1,398 tpd
Corrugating medium—382 tpd

ONTONAGON, MICH.
(Formerly Champion International Corp. mill)
Pulp—550 tpd semichemical
Corrugating medium—681 tpd

MISSOULA, MONT.
(Formerly Champion International Corp. mill)
Pulp—1,900 tpd unbleached kraft
Linerboard—1,962 tpd unbleached

COSHOCTON, OHIO
Pulp—600 tpd semichemical
Corrugating medium—859 tpd

YORK, PA.
(Formerly Champion International Corp. mill)
Corrugating medium—268 tpd
Specialty paper/board—118 tpd

FLORENCE, S.C.
Pulp—1,400 tpd unbleached kraft
Linerboard—1,394 tpd
Kraft paper—397 tpd

HOPEWELL, VA.
Pulp—1,000 tpd unbleached kraft
Linerboard—1,182 tpd

SNOWFLAKE, ARIZ.
(Southwest Forest Industries mill)
Pulp—700 tpd kraft; 200 tpd groundwood; 600 tpd deinked news
Newsprint—800 tpd
Kraft linerboard—450 tpd

PANAMA CITY, FLA.
(Southwest Forest Industries mill)
Pulp—660 tpd hardwood or fluff
Linerboard—800 tpd

Total production capacity:

PULP	
Kraft	8,580 tpd
Semichemical	1,450 tpd
Deinked	600 tpd
Groundwood	180 tpd
Total	10,810 tpd

PAPER AND BOARD	
Linerboard	7,300 tpd
Corrugating medium	2,420 tpd
Kraft paper	1,965 tpd
Newsprint	800 tpd
Specialty paper/board	118 tpd
Total	12,003 tpd

Stora

Papyrus Newton Falls Inc.
Box 253
Newton Falls, N.Y. 13666
Leif Smedman, president/CEO

Stora Forest Industries Ltd.
Box 59
Port Hawkesbury, N.S. B02 2V0
Tom R. Hall, president/general manager

(Stora reorganized following its acquisition of AB Papyrus. In 1987, it placed Newton Falls Paper Mill Inc. under the Papyrus fine paper operations umbrella, and in 1989, it changed the name to Papyrus Newton Falls Inc.)

Financial data not available.

Newton Falls planned to add No. 1 coated glossy paper to its line in fall 1987 to make up for market share that No. 3 grade is losing to low-cost, high-quality No. 4 grades.

Stora Forest Industries Ltd. is the largest forest products company in Nova Scotia, producing approximately 174,000 metric tons of newsprint and 160,000 metric tons of bleached sulfite market pulp.

The sulfite pulp mill began operations in 1962, and a newsprint mill was added in 1971. The market pulp mill and newsprint mill, while having a common wood supply system, are two completely separate operations, with the entire market pulp production available to the world market. The newsprint mill is supplied by high-yield sulfite and stone groundwood operations.

Stora Forest Industries is a wholly owned Canadian subsidiary of Stora, Sweden.

Stora Forest Industries owns 54,361 acres of timberland and controls an additional 1,482,580 acres.

Production facilities (1988 figures):

NEWTON FALLS, N.Y.
(Newton Falls Paper Mill Inc.)
Paper—400 short tpd (363 metric) fine

POINT TUPPER, N.S.
(Stora Forest Industries)
Pulp—440 metric tpd bleached sulfite (for market); 125 tpd high-yield sulfite; 350 tpd groundwood
Newsprint—425 metric tpd

Total production capacity:

PULP (metric tons)	
Sulfite	440 tpd
High-yield sulfite	125 tpd
Groundwood	350 tpd
Total	915 tpd

PAPER (metric tons)	
Newsprint	425 tpd
Fine papers	363 tpd
Total	788 tpd

Temple-Inland Inc.

303 South Temple Drive
Diboll, Texas 75941
Clifford J. Grum, president/chief executive officer of Temple-Inland Inc.
Ben J. Lancashire, executive vice president of Temple-Inland Inc.; president/chairman/chief executive officer of Inland Container Corp.

(Temple-Inland Forest Products Corp. and Inland Container Corp. are wholly owned subsidiaries of Temple-Inland Inc.)

Net sales:	
1989	$1,894,200,000
1988	1,773,500,000
1987	1,602,700,000
1986	1,295,807,000
1985	1,243,100,000
Net income:	
1989	$207,400,000
1988	199,200,000
1987	141,400,000
1986	80,800,000
1985	85,100,000

Container/containerboard (Inland Container)	
Revenues:	
1989	$1,138,400,000
1988	1,093,100,000
1987	964,200,000
1986	721,700,000
1985	684,200,000
Income before taxes:	
1989	$208,400,000
1988	221,300,000
1987	150,800,000
1986	38,800,000
1985	49,700,000

Pulp/paperboard (Temple-Inland Forest Products)	
Revenues:	
1989	$368,300,000
1988	336,000,000
1987	292,500,000
1986	264,900,000
1985	256,700,000
Income before taxes:	
1989	$114,900,000
1988	$82,700,000
1987	53,400,000
1986	29,400,000
1985	19,800,000

Temple-Inland is a holding company with major interests in paper, packaging, building products, and financial services. The company feels the way to gain competitive advantage in such a competitive industry is by being a low-cost producer and manufacturer of a balanced blend of products, including specialty items having higher profit margins.

In 1988, the company's Temple-Eastex Inc. subsidiary changed its name to Temple-Inland Forest Products Corp.

The company has capacity for 1,490,000 tpy of linerboard, 480,000 tpy of corrugating medium, and 600,000 tpy of bleached pulp.

Of total Temple-Inland revenues in 1989, Inland Container accounted for 59%, and Temple-Inland Forest Products accounted for 32% (not including building products). Inland Container makes containerboard and corrugated packaging. Its output of linerboard and corrugating medium in 1989 was 1,897,000 tons. Temple-Inland Forest Products makes bleached paperboard and building materials. It produced 579,000 tons of paperboard and bleached pulp in 1989, down from 602,000 tons in 1988.

Capital expenditures for container and containerboard in 1989 were $ 163.0 million. Spending for pulp and papermaking operations was $33.3 million.

In 1989, Inland's Rome, Ga., and Orange, Texas, mills both completed modernization programs. Rome's upgrade will increase the mill's capacity by 25%, and production at Orange has already increased 8%. Approved and begun during 1989 were similar modernization programs at corrugating medium mills in New Johnsonville, Tenn., and Newport, Ind. The company has also approved plans to build an 800-tpd recycled linerboard mill in

Maysville, Ky., set for completion in 1992.

The company owns 1,724,162 acres of timberlands in the southern U.S. and controls 100,000 additional acres.

Production facilities:

NEWARK, CALIF.
(Inland Container)
Corrugating medium—175 tpd

ONTARIO, CALIF.
(Inland Container)
Recycled linerboard—575 tpd

ROME, GA.
(Inland-Rome; former Georgia Kraft Co. mill)
Pulp—2,000 tpd unbleached kraft
Linerboard—2,100 tpd

NEWPORT, IND.
(Inland Container)
Corrugating medium—575 tpd

NEW JOHNSONVILLE, TENN.
(Inland Container)
Pulp—375 tpd semichemical
Corrugating medium—575 tpd

EVADALE, TEXAS
(Temple-Inland Forest Products)
Pulp—1,650 tpd bleached kraft
Bleached board—1,650 tpd
ORANGE, TEXAS
Pulp—1,400 tpd unbleached kraft
Linerboard—1,400 tpd

Total production capacity:

PULP	
Kraft	5,050 tpd
Semichemical	375 tpd
Total	5,425 tpd
PAPERBOARD	
Bleached board	1,650 tpd
Linerboard	4,075 tpd
Corrugating medium	1,325 tpd
Total	7,050 tpd

Union Camp Corp.

1600 Valley Rd.
Wayne, N.J. 07470
R.E. Cartledge, chairman/chief executive officer

Net sales:	
1989	$2,761,337,000
1988	2,660,918,000
1987	2,361,684,000
1986	2,092,247,000
1985	1,865,871,000
Net income:	
1989	$299,400,000
1988	295,146,000
1987	207,483,000
1986	129,934,000
1985	95,092,000

Union Camp bases its strategy on large-scale integrated mills producing linerboard, kraft paper, and white papers. In addition to pulp and paper, Union Camp has woodlands, converted products, chemicals, building products, and land resources operations. Union Camp produces uncoated bond, copy, tablet, duplicating, and offset papers; coated and uncoated bristols; kraft paper; linerboard; and saturating kraft.

Paper and paperboard contributed $1.697 million toward total sales in 1989. Paper and board shipments in 1989 were 1,552,939 tons.

Capital spending totaled $563 million in 1989 ($403 million for pulp and paper projects), and $850 million was forecasted for 1990. In early 1989, Union Camp completed a $173-million modernization/expansion program at its Prattville, Ala., linerboard mill. The project increased capacity to 2,400 tpd.

In 1988, the company announced two major capital programs totaling $1.1 billion. The first—a $375-million, three-year modernization program at the Savannah, Ga., mill—includes a 1,300-tpd linerboard machine and retirement of two older machines. The program will increase mill production by 150,000 tpy while reducing direct manufacturing costs by about 12%.

The second program is a $700-million expansion of the Eastover, S.C., uncoated free-sheet mill. When completed in mid-1991, the project will provide an incremental 1,100 tpd, which will ultimately split out at 800 tpd of uncoated free-sheet and 300 tpd of bleached softwood market pulp.

Union Camp owns 1,678,000 acres of timberland and controls an additional 16,000 acres.

Production facilities:
(1990 available capacity)

PRATTVILLE, ALA.
Pulp—2,400 tpd kraft
Linerboard—2,400 tpd

SAVANNAH, GA.
Pulp—2,900 tpd kraft
Linerboard—1,500 tpd
Unbleached paper—1,350 tpd

EASTOVER, S.C.
Pulp—700 tpd bleached kraft
Bleached paper—675 tpd

FRANKLIN, VA.
Pulp—2,000 tpd kraft
Bleached paper/board—1,975 tpd

Total production capacity:

PULP	8,000 tpd
PAPER AND BOARD	
Unbleached paper	1,350 tpd
Bleached paper/board	2,650 tpd
Linerboard	3,900 tpd
Total	7,900 tpd

United States Gypsum Co.

(Subsidiary of USG Corp.)
101 S. Wacker Dr.
Chicago, Ill. 60606
Eugene B. Connolly, president/chief executive officer

(Figures below are for USG Corp.)

Net sales:	
1989	$2,191,000,000
1988	2,248,013,000
1987	2,898,063,000
Net earnings:	
1989	$28,000,000
1988	125,441,000
1987	204,289,000

USG Corp. was organized in January 1985 as the holding company for several operating subsidiaries that manufacture and market products for the building products and industrial processes markets. Gypsum linerboard is included in U.S. Gypsum's Gypsum Products operations; insulation board is part of Wood Fiber operations.

U.S. Gypsum is the leading manufacturer of gypsum products in North America. The company accounts for a market-leading 34% of total gypsum board sales in the U.S.

U.S. Gypsum had sales of $1.032 million in 1989, compared with $1.119 million in 1988. The company's plants operated near capacity throughout 1989.

As part of a USG Corp. restructuring plan, U.S. Gypsum sold its construction and metal business and certain other plants in 1989. It also undertook several plant expansions. Among these was a second gypsum wallboard line, which opened at the Sperry, Iowa, plant in early 1989. Within three weeks of startup the plant was running at 100% capacity.

Production facilities:

SOUTH GATE, CALIF.
Gypsum board liner—200 tpd
Saturating felt—70 tpd (Mill idle)

JACKSONVILLE, FLA.
Gypsum board liner—190 tpd

NORTH KANSAS CITY, MO.
Gypsum board liner—130 tpd

CAMDEN, N.J.
Gypsum board liner—130 tpd

CLARK, N.J.
Gypsum board liner—396 tpd

OAKFIELD, N.Y.
Gypsum board liner—105 tpd

GYPSUM, OHIO
Gypsum board liner—105 tpd

OAKMONT, PA.
(Mill idle)
Paper—60 tpd bag and grocery sack

GALENA PARK, TEXAS
Gypsum board liner—175 tpd

Total production capacity:

PAPER AND BOARD	
Gypsum board liner	1,441 tpd
Saturating felt	70 tpd
Paper	60 tpd
Total	1,561 tpd

Virginia Fibre Corp.

P.O. Box 339
Amherst, Va 24521
Charles R. Chandler, president/chief operating officer

(Greif Bros. Corp. has a 50% limited partnership interest in Virginia Fibre.)

Net sales:	
1989	$87,009,000
1988	83,335,000
1987	75,102,000
Net income:	
1989	$19,924,000
1988	16,105,000
1987	10,448,000
1986	2,935,000
1985	5,000,000

(fiscal year ends Sept. 30)

Virginia Fibre is a major producer of semichemical corrugating medium. The company produced 248,745 tons of paper and paperboard and 197,293 tons of pulp in 1989. Capital expenditures reached $15.4 million in 1989 and were expected to drop to $7.5 million in 1990. A $14.3-million, 500-tpd old corrugated container plant was to start up in fiscal year 1990, completing Phase One of the company's mill modernization. Phase Two is defined as a rebuild of the stock preparation facilities and is expected to be completed in 1991 at a cost of $10.0 million. Also scheduled for 1991 is the startup of a landfill operation with an initial cost of $2.5 million.

Production facilities:
(1987 production estimates based on 354 days' operation)

RIVERVILLE, VA.
Pulp—560 tpd semichemical; 500 tpd recycled fiber
Semichemical corrugating medium—725 tpd)

Total production capacity:

PULP	1,060 tpd
PAPERBOARD	725 tpd

Waldorf Corp.

2250 Wabash Ave., Box 64260
St. Paul, Minn. 55164
Gene Frey, president

Net sales:	
1989	n.a.
1988	$136,824,000
1987	122,222,000
1986	108,092,000
1985	108,259,000
1984	105,525,000

(fiscal year ends June 30)

Waldorf reappeared as a name in the industry when Trident Associates Inc. bought two mills from Champion International Corp. and created a new company. It chose part of the name of Hoerner Waldorf Corp., which had operated a folding carton division bought by Champion in 1977. Champion had owned the St. Paul, Minn., mill and acquired the Battle Creek, Mich., mill along with St. Regis Corp. In addition to the two mills, Waldorf has six folding carton plants.

Production facilities:

BATTLE CREEK, MICH.
Recycled board—325 tpd

ST. PAUL, MINN.
Recycled medium—400 tpd
Recycled board—375 tpd

Total production capacity:

PAPERBOARD	
Recycled medium	400 tpd
Recycled board	700 tpd

Weldwood of Canada Ltd.

1055 W. Hastings St., Box 2179
Vancouver, B.C. V6B 3V8
Thomas Buell, chairman/president

(In early 1988, Weldwood got approval from shareholders to purchase Champion International Corp.'s St. Regis Paper Co. [Canada] Ltd., which included Champion Forest Products [Alberta] Ltd. [of which the Hinton, Alta., market pulp mill is a part] and St. Regis Resources Ltd. [oil and gas]. In exchange, Champion's share in Weldwood was boosted from 71.8% to 84.6%. Weldwood owns 50% of Cariboo Pulp & Paper Co.; Daishowa-Marubeni International Ltd. owns 50%.]

Net sales:	
1989	C$767,500,000
1988	894,500,000
1987	741,035,000
1986	658,946,000
Net income:	
1989	C$65,400,000
1988	62,100,000
1987	47,592,000
1986	30,037,000

Weldwood produced 415,000 metric tons of pulp in 1989Weldwood spent C$202.5 million in capital expeditures in 1989, C$189.1 million of which was spent on pulp operations. Expenditures were expected to drop to C$90 million in 1990.

The expansion at Cariboo Pulp & Paper in Quesnel, B.C., was completed in June 1989, raising the mill's annual production capacity to 330,000 metric tpy. Production for the year was 247,000 metric tons compared with 274,000 metric tons in 1988, reflecting downtime necessary to implement the expansion project. The company expected to achieve capacity production by the end of 1990. Also in 1990, the mill was to commence installation of a C$35-million oxygen delignification system.

The C$361-million expansion at the Hinton, Alta., mill to increase bleached softwood kraft pulp output entered its startup phase at the end of 1989 and is expected to reach its production capacity of 385,000 metric tpy by the end of 1990.

Weldwood owns 40,000 acres of timberland in Canada and controls an additional 1,960,000 acres.

Production facilities:

HINTON, ALTA.
Pulp—549 metric tpd kraft

QUESNEL, B.C.
(Cariboo Pulp & Paper Co.)
Pulp—930 metric tpd bleached kraft
(Weldwood's share: 465 tpd)

Total production capacity:

PULP	1,014 metric tpd

Westvaco Corp.

299 Park Ave.
New York, N.Y. 10171
David L. Luke III, chairman
John A. Luke, president/chief executive officer

Net sales:	
1989	$2,284,059,000
1988	2,133,889,000
1987	1,903,606,000
1986	1,811,937,000
1985	1,721,783,000
Net income:	
1989	$223,090,000
1988	200,434,000
1987	146,191,000
1986	108,096,000
1985	104,625,000

(fiscal year ends Oct. 31)

Westvaco manufactures a broad range of high-quality papers for graphic reproduction, communications, and packaging in the U.S., and it has paper and packaging interests in Brazil. It is a major manufacturer of consumer and industrial packaging and one of the world's largest producers of envelopes. It also produces specialty chemicals and develops land for commercial and residential use.

Westvaco emphasizes higher-value-added, differentiated products, and it has one of the biggest research and development budgets in the industry—more than $31 million in 1989. The company's new products include papers for high-quality printing and graphic arts, bleached paperboard to replace glass or plastic packaging, and saturating kraft used in decorative laminates.

Sales of bleached pulp, paper, and paper products were $1,473.8 million in 1989, and unbleached paper and products sales were $604.0 million.

In 1989, the company produced 123,084 tons of market pulp and 2,376,308 tons of paper and paperboard.

Capital expenditures in 1989 were $536.9 million. The company spent $418.9 million on bleached pulp, paper, and paper products and $93.1 million on unbleached paper and products. Capital spending in 1990 was expected to reach $525 million.

In 1989, Westvaco announced plans to spend $530 million for a new bleached paperboard machine and additional pulping and chemical recovery capacity at its Covington, Va., mill.

Westvaco owns 1,355,600 acres of timberland in the U.S.

Production facilities:

WICKLIFFE, KY.
(Fine Papers Div.)
Pulp—906 tpd bleached kraft
Fine papers—600 tpd

LUKE, MD.
(Fine Papers Div.)
Pulp—1,075 tpd bleached kraft
Fine papers—1,400 tpd
TYRONE, PA.
(Fine Papers Div.)
Fine papers—220 tpd

CHARLESTON, S.C.
(Kraft Div.)
Pulp—2,594 tpd unbleached kraft
Paperboard—2,400 tpd

COVINGTON, VA.
(Bleached Board Div.)
Pulp—1,436 tpd bleached kraft; 196 tpd semichemical
Paperboard—1,656 tpd
Corrugating medium—294 tpd

Total production capacity:

PULP	
Kraft	6,011 tpd
Semichemical	196 tpd
Total	6,207 tpd

PAPER AND BOARD	
Fine papers	2,220 tpd
Corrugating medium	294 tpd
Paperboard	4,056 tpd
Total	6,570 tpd

Weyerhaeuser Co.

Tacoma, Wash. 98477
George H. Weyerhaeuser, chairman/chief executive officer

(Weyerhaeuser Canada Ltd. is a wholly owned subsidiary. Weyco owns 80% of North Pacific Paper Corp.; Jujo Paper Co. Ltd. of Japan owns 20%.)

Net sales:	
1989	$8,280,754,000
1988	7,862,505,000
1987	6,989,829,000
1986	5,652,029,000
1985	5,205,579,000

Net earnings:	
1989	$376,838,000
1988	515,796,000
1987	379,015,000
1986	179,645,000
1985	131,678,000
1984	174,502,000

Weyerhaeuser Co. is composed of three principal business groupings: Weyerhaeuser Forest Products Co., Weyerhaeuser Paper Co., and Weyerhaeuser Diversified Companies, which has interests in real estate and financial services. The company is going through a major restructuring that is narrowing the portfolio of businesses with an effort to drastically improve its competitive position. Paper Co. is taking each business division through a refocusing process that will include some divestitures as well as some facility expansions. This will improve productivity and cost and will strengthen quality and market position.

Paper Co. net sales totaled $3.7 billion in 1989, and operating earnings were $617 million after a $55-million restructuring change.

In 1989, output of pulp reached 1,275,000 metric tons; newsprint, 485,000 metric tons; paper, 919,000 short tons; paperboard, 221,000 short tons; and containerboard, 2,168,000 short tons.

Paper Co. capital expenditures in 1989 were $613 million.

The new $400-million, 425,000-tpy bleached pulp mill started up in Columbus, Miss., in mid-1990. The pulp mill will integrate the existing lightweight coated machine and help maintain the status as one of the world's largest market pulp suppliers. The company has begun construction of a $300-million addition to the Longview, Wash., newsprint mill (NORPAC). It will feature a 230,000-metric-tpy newsprint machine and one of the largest deinking facilities for the use of recycled newsprint in North America. Startup is scheduled for mid-1991. The company also operates one of the nation's largest wastepaper recycling systems and has added two more facilities, taking capacity to over 1.2 million tpy.

Weyerhaeuser owns approximately 5.7 million acres of commercial forestland in the U.S., and it has long-term licensing arrangements for about 9 million acres in Canada.

Production facilities:

COLUMBUS, MISS.
Pulp—260 tpd thermomechanical
Lightweight coated paper—570 tpd

NEW BERN, N.C.
Pulp—750 tpd bleached kraft (for market)

PLYMOUTH, N.C.
Pulp—1,000 tpd kraft (264 for market); 220 tpd semichemical
Linerboard—620 tpd
Corrugated medium—410 tpd
Uncoated free-sheet—850 tpd

VALLIANT, OKLA.
Pulp—1,900 tpd kraft; 410 tpd semichemical
Linerboard—2,010 tpd
Corrugating medium—570 tpd

NORTH BEND, ORE.
Pulp—300 tpd semichemical
Corrugating medium—550 tpd

SPRINGFIELD, ORE.
Pulp—1,150 tpd kraft
Containerboard—1,450 tpd

COSMOPOLIS, WASH.
Pulp—400 metric tpd sulfite (for market)

EVERETT, WASH.
Pulp—395 metric tpd kraft (for market)

LONGVIEW, WASH.
Pulp—780 tpd kraft (some for market); 200 tpd semichemical
Corrugating medium—320 tpd
Bleached paperboard—620 tpd

LONGVIEW, WASH.
(North Pacific Paper Co.)
Pulp—1,375 tpd thermomechanical
Newsprint—1,440 tpd

LONGVIEW, WASH.
(R-W Paper Co.)
Uncoated free-sheet—360 tpd

ROTHSCHILD, WIS.
Pulp—200 tpd sulfite
Uncoated free-sheet—350 tpd

KAMLOOPS, B.C.
(Weyerhaeuser Canada Ltd.)
Pulp—1,230 metric tpd (1,350 short) kraft (for market)

PRINCE ALBERT, SASK.
(Prince Albert Pulp & Paper, div. of Weyerhaeuser Canada Ltd.)
Pulp—920 metric tpd (1,010 short) bleached kraft (for market)
Uncoated free-sheet—600 metric tpd

Total production capacity:

PULP	
Kraft	8,900 tpd
Semichemical	835 tpd
Sulfite	515 tpd
TMP	1,540 tpd
Total	11,750 tpd

SECONDARY FIBER	
Total	3,400 tpd

PAPER AND BOARD	
Uncoated free-sheet	2,060 tpd
Lightweight coated	580 tpd
Newsprint	1,350 tpd
Bleached paperboard	625 tpd
Linerboard	4,085 tpd
Corrugating medium	1,865 tpd
Total	10,525 tpd

Willamette Industries Inc.

3800 First Interstate Tower
Portland, Ore. 97201
William Swindells, chairman/president/chief executive officer

Net sales:	
1989	$1,891,824,000
1988	1,716,021,000
1987	1,431,624,000
1986	1,200,155,000
1985	1,152,067,000
Net earnings:	
1989	$191,056,000
1988	161,087,000
1987	121,339,000
1986	74,665,000
1985	60,244,000
1984	61,021,000

Willamette Industries is a diversified, integrated forest products company with 71 plants in 17 states, manufacturing containerboard, fine paper, bleached hardwood market pulp, corrugated containers, business forms, xerographic copy paper, paper bags, lumber, plywood, particleboard, and medium-density fiberboard.

Willamette's pulp and paper sales were about $315 million in 1989—16% of total sales. Total pulp and paper production was 1,390,000 tons—fairly close to company capacity of 1,481,000 tons.

Total capital expenditures in 1989 were $280.0 million, $56 million of which went to improvements at Willamette's manufacturing facilities.

The company started up its 200,000-tpy uncoated free-sheet mill near Bennettsville, S.C. The mill doubles production capacity of fine paper and will reposition Willamette from being a net buyer to a net seller of fine paper. In the spring, the company acquired Penntech Paper, a nonintegrated white paper mill in Johnsonburg, Pa.

Also under way is the capacity expansion at Willamette's Hawesville, Ky., corrugating medium mill.

In 1990, the company announced plans to build a corrugated container plant in the Houston, Texas, area.

Willamette owns or controls 1,020,000 acres of timberland in the U.S.

Production facilities:

PORT HUENEME, CALIF.
Recycled paperboard (corrugating medium, linerboard)—408 tpd

HAWESVILLE, KY.
(Kentucky Mills: bleached pulp, fine paper)
Pulp—735 tpd bleached hardwood kraft (350 tpd for market)

HAWESVILLE, KY.
(Kentucky Mills: corrugating medium)
Pulp—300 tpd semichemical
Corrugating medium—385 tpd

HAWESVILLE, KY.
(Kentucky Mills: fine paper)
Fine paper—518 tpd

CAMPTI, LA.
(Red River Mill Div.)
Pulp—800 tpd unbleached kraft
Kraft linerboard—1,079 tpd

ALBANY, ORE.
Pulp—580 tpd kraft; 200 tpd semichemical
Kraft linerboard, paper—900 tpd
Corrugating medium—285 tpd

BENNETTSVILLE, S.C.
Pulp—790 tpd kraft
Printing/writing paper—575 tpd

Total production capacity:

PULP	
Kraft	2,905 tpd
Semichemical	500 tpd
Total	3,405 tpd

PAPER AND BOARD	
Fine paper	1,093 tpd
Kraft linerboard, paper	1,979 tpd
Corrugating medium	670 tpd
Recycled linerboard, medium	408 tpd
Total	4,150 tpd